THE

SCREW PROPELLER:

WHO INVENTED IT?

WITH

Illustrations.

BY

ROBERT WILSON, F.R.S.E., F.R.S.S.A.,

OF THE FIRM OF MESSRS. NASMYTH, WILSON, AND CO., BRIDGEWATER FOUNDRY, PATRICROFT, NEAR MANCHESTER.

Screw Propellers experimented with by the Author from 1819 to 1833.

"The introduction of a new art constitutes a salient feature of an age; and the rewards due to such an achievement should not be grudgingly measured out by the legal standard of merit, which recognises only the conditions of routine practice, but should be referred to a higher tribunal, which, taking cognisance of the difficulties surmounted and the public benefits conferred, should decide in accordance with the spontaneous dictates of plain sense and plain honesty."—"The Screw Propeller," by John Bourne, C.E.

SECOND EDITION, WITH APPENDICES A AND B.

GLASGOW: THOMAS MURRAY & SON.
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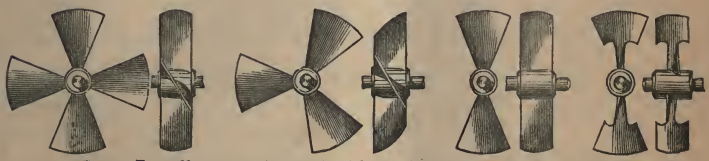

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TO THE

Royal Scottish Society of Arts

AND THE

Highland and Agricultural Society of Scotland,

THE EARLIEST ENCOURAGERS OF MY EFFORTS TO INTRODUCE THE SCREW PROPELLER,

I Dedicate

THE FOLLOWING PAGES, IN TESTIMONY OF GRATITUDE, AND OF MY HUMBLE APPRECIATION OF THEIR INVALUABLE AID IN THE CAUSE OF SCIENCE.

ROBERT WILSON.

Ellesmere House,
Patricroft, Manchester.

PREFATORY NOTE.

THE first Edition of this Pamphlet being exhausted, I, at the request of friends, have consented to the publication of this second Edition, to which has been added the Opinions of the Press.

I have also added an Appendix, at page 55, as to my improvements of the Fish Torpedo. The Government, in acknowledgment of these improvements, recently awarded me Five Hundred Pounds.

R. W.

October, 1880.

INTRODUCTION.

STEAM NAVIGATION, which has done so much for the prosperity of Nations and the grandeur of Britain, has called forth many Inventions, and amongst the most important of them is the SCREW PROPELLER.

This Invention, AS THE MOST SUITABLE FOR PROPELLING SHIPS OF WAR AND OTHER OCEAN STEAMERS, I claim as my OWN, and I am confident I shall be able to establish by *documentary evidence* THAT I NOT ONLY INVENTED, AND TESTED ON THE SEA BEFORE COMMITTEES OF THE HIGHLAND SOCIETY AND SOCIETY OF ARTS, AND AT GREAT PERSONAL SACRIFICES USED ALL THE MEANS IN MY POWER TO INTRODUCE THE SCREW PROPELLER FOR OCEAN NAVIGATION LONG BEFORE MR. SMITH, the Patentee, (who has reaped the honours and rewards of the Invention,) HAD EVEN HIS ATTENTION DIRECTED TO THE SUBJECT; AND THAT THE SCREW MIGHT HAVE BEEN ADOPTED IN THE NAVY AS EARLY AS 1827, TO THE SAVING OF MILLIONS OF THE PUBLIC MONEY. In that year the Lords Commissioners of the Admiralty refused to countenance my Invention, though recommended to their notice by the Right Honourable the Earl of Lauderdale; and again in 1833 they rejected it *because*, (to quote from the official Report of the Officers of Woolwich Dockyard;*) "*it involved a greater loss of power than the common mode of applying the wheels to the side*," a decision which (as the Secretary of the Royal Scottish Society of Arts expressed it) "just resolved itself into a preference to *side paddles* over the *screw* or *stern paddles*." †

It may be asked why I have not earlier advanced my claims. To this I reply, that when in 1855 much was being said about Mr. Smith as the originator of the screw propeller, I received many friendly and pressing letters urging me to claim a share of the merit of the Invention. I, however, found upon examining my papers, that *the official Report of* 1833, *by the Officers of Woolwich*

* See Report, p. 36. † Excerpt from Letter to Mr. Wilson.

Dockyard, was amissing; and that this document seemed to me of essential importance to the establishment of my claim, is evidenced by the fact, that I wrote at the time to the Secretary of the Royal Society of Arts, the late James Tod, Esq., W.S., asking the favour of his applying to the Admiralty for a copy of it, which with his usual courtesy he at once did, but the following correspondence will show that his application was unsuccessful :—

LETTER I.—JAMES TOD, Esq., to ROBERT WILSON.

EDINBURGH, 55 GREAT KING STREET,
1*st December*, 1855.

Mr. ROBERT WILSON,
Low Moor Iron Works,
Near Bradford, Yorkshire.

DEAR SIR,

I have your letter of the 29th ult. From the letter of mine to the late Sir Thomas Dick Lauder, 24th January, 1833, I observe that it was proposed to transmit the Society's account of the experiments made under their inspection with your "Stern Paddles" or Screw, to Captain the Honourable George Elliot, Secretary of the Admiralty, with a recommendatory letter from the Solicitor-General, which letter should be signed also by Sir Thomas Dick Lauder, as convener of the Experimenting Committee, as also by Vice-Admiral Sir David Milne, Sir John Sinclair, and any other influential person acquainted with the subject; that this letter, together with copies of the papers read before the Society, with relative drawings and report of the Committee, should be transmitted to Captain Elliot, with a private letter of recommendation from the Solicitor-General.

Now, from the great interest Sir John Sinclair took in this matter, and from his having received a letter on the subject from the Duke of Richmond, and from the circumstance of my finding, in my letter-book, my correspondence with him and Sir Thomas Dick Lauder on the subject of your invention, but no letter to Captain Elliot, I am inclined to think that the papers must have been transmitted to the Admiralty either by *Sir John Sinclair*, or by *Admiral Fleming;* to the latter of whom, as shown by the letter you send me from the Admiralty of 18th September, 1833, they would appear to have been returned along with the report by the Officers of the Woolwich Dockyard.

I have written to the present Secretary to the Admiralty, the letter, of which copy is enclosed, requesting him to furnish me with another copy of that report, and if I get it you may depend on my forwarding it to you.

I should be exceedingly well pleased to see your merits recognised as the original inventor of the "Screw Propeller,"

And am, etc.,

(Signed) JAMES TOD, Secretary.

LETTER II.—JAMES TOD, Esq., to the SECRETARY OF THE ADMIRALTY above referred to.

ROYAL SCOTTISH SOCIETY OF ARTS,
EDINBURGH, 55 GREAT KING STREET, 1*st December*, 1855.

SIR,

In the year 1833, they were transmitted to the Admiralty reports by the Society of Arts in Scotland (now the Royal Scottish Society of Arts), detailing the experiments performed in Leith Roads, under the Society's superintendence, with *Robert Wilson's Stern Paddles or Screw*, and recommending their Lordships to try it on a larger scale, as being in the Society's opinion *an invention of great importance both for the Royal Navy and Commercial Marine.*

I believe it was recommended to the consideration of the Lords of the Admiralty by the late Sir John Sinclair, Bart., the late Admiral Sir David Milne, the late Sir Thomas Dick Lauder, the Solicitor-General, and others.

By a letter from the Secretary of the Admiralty, addressed to Vice-Admiral the Honourable C. E. Fleming, dated 18th September, 1833, which is now before me, I observe that their Lordships had referred the documents sent them to the Officers of Woolwich Yard, and that these documents were returned to Admiral Fleming, with a copy of their Report thereon.

That letter came into the possession of Mr. Wilson, the inventor, and he is very desirous of having a copy of the Report, by the Officers of Woolwich Yard, referred to in the letter. He has accordingly requested me to apply to you for a copy of that Report, which I will take it kind of you to transmit to me as Secretary of said Society, as Mr. Wilson is not aware where the original copy is to be found, which was sent to Admiral Fleming.

I have the honour, etc.,

(Signed) JAMES TOD, Secretary,
Royal Scottish Society of Arts.

LETTER III.—Mr. TOD, in Reply by the SECRETARY OF THE ADMIRALTY.

ADMIRALTY, 18*th December*, 1855.

SIR,

In reply to your letter of the 1st instant, requesting to be supplied with a copy of the Report by the Officers of Woolwich Dockyard in 1833

on Mr. Wilson's invention of Stern Paddles or Screw, I am commanded by my Lords Commissioners of the Admiralty to acquaint you that their Lordships cannot comply with your request.

I am, etc.,

(Signed) THOMAS PHINN.

Shortly after this I had the good fortune to discover the missing Report, but my numerous engagements at that time, and a strong personal disinclination to obtrude myself on public notice, will account for my delay in taking further steps. It is only now, after mature consideration, I have come to think that, in justice to the Scottish Societies, as well as to the noblemen and gentlemen after mentioned, and to myself, and in deference to the wishes of my friends, I should no longer remain silent. I shall, however, confine myself almost exclusively to a simple narrative of facts, and leave the public to draw their own inferences as to the credit to be given thereto. I will show that the idea of the screw propeller took posession of my mind as early as 1808, and subsequently cost me much labour and expense; that after many discouragements, my invention attracted public notice,; that in 1827 the Earl of Lauderdale brought it before the Admiralty, in order to have its merits tested on a large scale, but failed to impress upon the Lords Commissioners of that department the importance of it; that in 1828 the *Highland Society of Scotland* reported highly of my invention, and after a series of experiments made in Leith Roads, with a boat fitted with my screw propellers, voted me a grant; that in 1832 another series of experiments was made in Leith Roads, with a boat fitted with my screw propellers —or, as they were then called, *revolving sculls*—under the auspices and at the expense of the Royal Scottish Society of Arts, and that the Council awarded to me a silver medal for the invention; that in the following year, 1833, the last-named Society sent a report of the experiments, and the whole of the machinery with which these experiments were made, and relative documents to the Admiralty; and that, as already stated, the officers of the Dockyard thereupon condemned the screw as objectionable, without even giving it a trial, and that *nine years* after my first efforts to introduce the screw propeller, I was obliged, owing to this second Government repulse, to stand aside and see the fruits of the labour of years pass

away from me, in consequence of Mr. Smith (who does not appear to have known anything of the screw until 1835) having found friends with sufficient confidence in the invention, to advance the means for obtaining a patent, and, supported by public opinion, having got the Government a few years afterwards to adopt the screw propeller.

Over the merit due to Mr. Smith as patentee, and for the spirit with which his idea was carried out, I desire not to throw even the shadow of detraction; but looking to the immense advantages which have resulted from the introduction of the screw propeller,* I trust that neither scientific men nor the public will refuse to give a candid consideration to my claim as prior inventor of the screw propeller for Ocean Navigation.

That truth in regard to the early history of screw propulsion is apt to be lost sight of, will sufficiently appear from the fact, that in a paper issued in 1850 by the Steam Department of the Admiralty, it is stated that a Report (dated May 2, 1840, and signed "*E. Chappell*, Captain," and "*T. Lloyd*") in regard to the *Archimedes* screw vessel, that Mr. Smith's patent "was *the first official one made to the Board on the subject of screw propulsion!*" whilst, on the contrary, it is certain that there was an official Report on this subject (a copy of which will be found at page 36), rejecting the screw propeller as invented by me, as early as 1833! Again, in Mr. Bourne's work on the screw propeller—the best authority on the subject extant—it is stated that amongst the screws exhibited by Mr. Smith at the Great Exhibition, was "the actual propeller used by Mr. Smith in his experimental Boat, of six horse power, in 1836-37, on the Paddington Canal, and with which he performed *the first sea trip ever made with a screw propeller!!*" whereas the fact is that, in April, 1828, in the presence of Vice-Admiral Sir David Milne, and many others, a Boat fitted with my propellers accomplished a trip in a heavy sea, carrying at the same time seven individuals (see page 25), and attained an average speed of ten miles an hour. Surely in the face of such errors as these the actual truth should be proclaimed.

* For Evidences of Advantages up to 1856, see Appendix A, p. 48.

HISTORICAL SKETCH.

For the sake of perspicuity, and to facilitate reference, it will be advisable to narrate the history of my connection with the screw propeller under the following heads and dates :—

* Nearly all the incidents mentioned under these three heads can be spoken to by parties now living, many of them still residing in Dunbar.

1808-1812.—First Thoughts on Screw Propulsion.

In 1808, I resided at my native place, Dunbar (a sea-port on the east coast of Scotland), and as I spent a great part of my time in aquatic amusements, and as my father was connected with the mercantile marine service, everything associated with the sea was to me specially interesting. In that year, and therefore long before the introduction of even side paddles for sea voyages, an ingenious private soldier (a native of Lanarkshire and a blacksmith by trade), then with his regiment quartered at Dunbar, fitted out a small fishing-boat with a pair of side paddles, probably for the purpose of showing their superiority over the ordinary pulling oars (of which side paddles may be said to be as much a modification as the screw propeller is of the sculling oar), and so quickly was the boat propelled in smooth water by the paddle wheels, that it was found the pulling oars with the application of the same amount of manual power could not compete with them. On a second trial, however, this time beyond the pier-head on the open sea, the change of circumstances was accompanied by adverse results, as the side paddles could not then compete with the pulling oars. The reason was obvious to those who witnessed the experiment, namely, that on account of the agitation of the water's surface, which on the open sea is seldom or never so smooth as in a harbour, river, or lake, the floats of the paddle wheels were either too deep in the water, and therefore choked, or nearly out of it and doing little more than skimming its surface, and thus producing little or no effect, and incapable of making headway against the wind and waves. The experiment clearly showed that his side paddles were not suitable for the open sea, or where the surface of the water was much agitated. I witnessed the experiments and the failure, and being an adept in sculling,* and moreover,

* This art of sculling, *i.e.*, propelling a boat by an oar at the stern, is quite familiar to all acquainted with boating. It may be mentioned that in China at this day junks are propelled by a long oar, fitted on a pivot at the stern, and worked by several Chinese, six being a common number; side oars being frequently used at the same time. Hooke, speaking in 1684 of the method of rowing ancient galleys, states that the oars were moved, not vibrating backwards and forwards and being lifted out of the water at each stroke as oars now are, but inwards and outwards as in sculling, the oar being held at the side, almost perpendicular, and consequently always immersed.

having what people call "an inventive turn of mind," the idea occurred to me that if anything like the oar used in the process of sculling could be fitted to the stern of boats and ships, and worked by machinery, such a contrivance would be free from the objections attaching to side paddles, seeing that the sculling oar not only went deep into the water when in action, but fish-tail-like went forward with the boat whilst in the act of propelling, and therefore did not require to be lifted out of the water to obtain a new hold, and was not affected so much as the pulling oar by the agitation of the water. The question, however, as to how the sculling oar was to be modified, so as to be driven by a constant motion like that applied to the paddle wheels, seemed to me at that time difficult to determine, as I was little acquainted with even the rudiments of mechanics, and the means within my reach were not such as could render me much assistance.

Two years passed away from the time of my witnessing the experiments with the side paddles, and when my desire to overcome the difficulty which presented itself to their use on the rough sea had grown stronger with time, an event happened which for a while turned my thoughts to graver concerns. This was the death of my father, who, after having assisted in the Dunbar life-boat in twice reaching the wreck of the "Pallas" Government Frigate (which was cast ashore near Dunbar in December, 1810), and thereby rescuing many of the crew, lost his life in a third attempt to save the remainder. Although the change of residence of my family, which followed this occurrence, separated me in some measure from my old pursuits, and prevented indulgence in my favourite pastime of boating, my thoughts, after a time, returned into their old channel, and I became as eager as before to solve the problem of how to modify the sculling oar to the purpose I had in view. At length, to my great satisfaction, I was led to a solution of the problem in a way very unexpected.

1812-1825.—Discovery of the Screw Propeller—Minor Model made—Experiments, etc.

When on a visit in the country, my attention was arrested by a running stream acting upon an undershot water wheel, a piece

of machinery I had never before seen. In this wheel I at once recognised a great similarity of construction to that of the paddle wheels of the soldier's boat before referred to. This caused me to examine the water wheel carefully, and I found that the only difference worthy of notice was in the action being reversed—that is, the water acted upon the wheel instead of the wheel upon the water, and thus gave motion and power to drive the machinery in the mill; while, in the case of the paddle wheels, they were driven by a separate power which, acting upon the water, propelled the boat. This discovery, simple as it may seem, ultimately led by further investigations (hereafter detailed) to an easy solution of my problem.

Shortly afterwards, while taking a walk in a different part of East Lothian, I saw, on the farm of Oxwellmains, a wind-mill used for thrashing corn, and, on inquiry, I learnt that it reefed and unreefed its own sails, and turned its face always towards the wind—*all by self-action or mechanical self-control.*

How this was effected I determined to discover; and a few days after I again returned to Oxwellmains, taking with me a small telescope to enable me more closely to examine the mechanical arrangement of the wind-mill. The mill was not working, and I had, therefore, a better opportunity of studying it. I lay down on the grass field in front of it, so as to use my knee as a rest for the telescope, and in this position, while engaged in wonder and admiration, trying to follow and account for the various motions which I knew the mill to have, an idea suddenly occurred to me, which rendered it perfectly clear in what way I could modify the sculling oar, so as to make it serve as a means of propelling a vessel. This was by putting it in the form of a *wind wheel*, such as that I had before me, which I saw embodied the very principle I had been in search of—being capable of adaptation for performing all the functions necessary for perfect action under water. It was now plain to me that, as the paddle wheel represented the undershot water wheel with its action reversed, so would also the modification of the sculling oar be in like manner a representation of the wind wheel with its action reversed; and as this wind wheel was acted upon by the medium (the atmosphere)—in which it was wholly immersed,

with equal force on each blade or arm during the whole of each revolution—so would each blade of the new revolving sculls act upon the water with equal force, if entirely immersed, during the whole of each revolution, and be little liable to be materially affected by agitation of the surface, which had so much affected the success of the soldier's experiments with the side paddles.

I therefore concluded that revolving sculls would be specially applicable to ocean propulsion, and I determined to make the demonstration of this opinion the object of my ambition. My energies, however, were cramped for a considerable time, owing to the want of the necessary means to carry out my ideas; but a small model in wood, with a set of four blades (Fig. 1), or revolving sculls, was made, and found to act as perfectly under water as I had seen the wind wheel do in the air. This, and similar subjects, gave my mind a more decided turn for mechanical pursuits; but, as no opening could be found in any local engineering establishment, and as I had arrived at an age at which it was necessary to learn a trade, I was bound apprentice to a joiner and cabinetmaker. While thus engaged, I amused myself with various inventions. One of these was a horizontal *wind wheel*, which seemed to possess so much power as a prime mover, that I thought it would answer to drive my new propellers, so that a vessel might run in any direction, and even against the wind. With this idea, a model vessel, about two-and-a-half feet in length, was constructed and fitted with a set of propellers (Fig. 2), and with a wind wheel

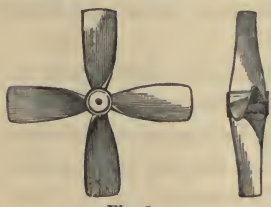


Fig. 1.
Sketch of the first Model of the revolving sculls made of wood.

Fig. 2.

Scale 1-6th of Model.

Model about 2 ft. 6 in. long and 6 in. broad, 1819 to 1821 and 1825, with clock-work.

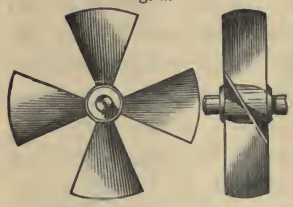
to drive them; but I found that the model made no headway against the wind, and the scheme was therefore considered a failure. Driving by wind-power, however, was not the principal object I had in view, and not being at that time sufficiently conversant with the steam engine, or any other prime mover likely to suit the purpose of driving the propellers, they were laid aside until 1821, when the "Tourist" steamer (fitted out for the Leith and Aberdeen Steam Boat Company by Mr Gutzmer of Leith) made her first series of sea voyages between Leith and London. In one of these trips, and when the vessel was off Dunbar, her steam-power was put to a severe test, owing to her having to encounter what is termed by the sailors, a *ground-swell*, that is, a heavy rolling sea unaccompanied by wind, and consequently very dangerous for vessels near the shore. Great fears were entertained for the vessel's safety, more especially as most people considered at that time that a steam voyage to London was little less than a tempting of Divine Providence.* The vessel was seen to roll from side to side, and at every roll to go almost on her beam ends; and as her paddles were alternately high in the air and buried in the water, the steam-power was to a great extent rendered useless. This spectacle gave me fresh energy, as I considered that the screw propeller (or revolving sculls) would have been much better for such a vessel, and that, with such a propeller and sufficient power, a steam boat might not only encounter a ground-swell without much inconvenience, but be safer in a storm than a paddle steamer or sailing vessel. I accordingly gave my screw the name of "Rough Sea or Storm Paddles," in contradistinction to side paddles, which I considered only suitable for smooth water, lake, or river navigation. In 1821, after making a number of experiments with the propeller, Fig. 2, I had to leave the coast to pursue my trade, and the subject again rested for a time.

* It is well known that Scotland was the first to solve the problem of steam navigation. The first *sea* voyage by steam and paddles was from Greenock to Belfast, in 1818, by the *Rob Roy* steam vessel. It is not surprising therefore that in 1821 people had little faith in steam boats for a sea voyage.

1825–1827.—Larger Model Made—Testing Screw—Comparative trials of Screw and Side Paddles.

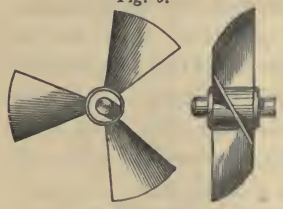
During my absence, my leisure time was frequently occupied in my favourite pursuits, and, on my return to Dunbar, four years afterwards, I made another model, and fitted it with a propeller driven by clock-work, moved by a strong main-spring of a time-piece. At first I used four blades, as Fig. *a*, in imitation of the wind-mill, already mentioned, so arranged that each blade was equal to about the eighth part of a whole turn of a four-threaded screw. Thinking, however, a still greater surface would be an improvement, four additional blades of the same proportions were introduced, but the disadvantage of this arrangement I found so great that the number was immediately reduced to the original four; and after numerous experiments with blades at various angles or pitches, and of different breadths, a further reduction was made in the number of blades, the power being reduced in about the same proportion, this being accomplished by increasing the number of turns of the propeller for each winding up of the spring. Three blades (Fig. *b*) were first tried, with nearly a corresponding reduction of power, when the advantage seemed so obvious as to induce a still further reduction to two blades (Fig. *c*,) with a corresponding lessening of power. It was then found that with the same proportion of blade as when four were used, and the power reduced one-half, or nearly so, the propellers making about double the number of turns each winding up of the spring, the model not only went as fast as with four blades, but nearly double the distance. A great many experiments were then made with the two-bladed screw, the vanes being set at various angles or pitches, and made of different breadths, but

Fig. *a*.



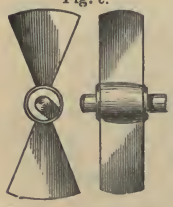
End view. Side view.

Fig. *b*.



End view. Side view.

Fig. *c*.



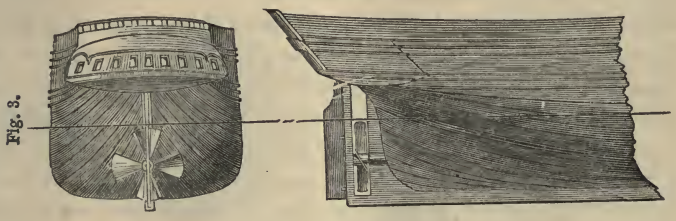
End view. Side view.

none of the blades which were tried by me exceeded one-sixth of a whole turn of a screw, as at that breadth they were found not to give such favourable results as with a less breadth; also several experiments with the inner part of the blades cut away to a sharp twisted arm (Fig. *d*,) the arm part being set with a twist corresponding to the speed of the model, or rather to the slip of the screw. This was found to be a great improvement, and with this kind of blade all the subsequent experiments were made, with the favourable results hereafter detailed.

Fig. *d*.

It may be proper here to mention that, in some of the first experiments, the propeller was placed in front of the rudder, as Fig. 3, and

Fig. 3. Stern. Side view.



1821 to 1825, with clock-work.

entirely under water, as Fig. 2 (the rudder being hung on a second or false stern-post), but the results were not so favourable as with the propeller behind the rudder, as Fig. 2;* the stuffing-box, however, in both cases, through which the propeller shaft worked, gave so much trouble and annoyance, by the water leaking through it (the power being much reduced when all was made tight), that it was resolved to make some fresh experiments with the shaft above the water-line, so as to avoid the annoyance of the leakage, which moreover injured the clock-work.

Seeing, at the same time, that by using two propellers instead of one, and running in opposite directions, they would balance the oblique action of each other, as the opposite blades do with one pro-

* Mr. Jack, engineer, Liverpool, informed the author, after reading his pamphlet, that he was much struck by reading these remarks, as he had found in shifting the propeller to behind the rudder the speed of three or four vessels had been increased about one-seventh, or from seven to eight knots per hour.

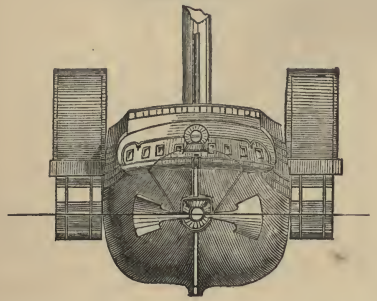
peller wholly immersed, and by having them double the diameter of the single one, they would be double the pitch with the same angle at the periphery or outer end of the blade, and so would give the same propelling power with half the number of revolutions, a model of about 3 feet long was made and fitted with screw propellers thus arranged, Fig. 4, and so satisfactory were the results, that the subsequent experiments were made with the propellers on this plan, though it was clear that for Ships of War, if not for all Ocean Steamers, it would be necessary, as in the first experiments, to have the propellers entirely under water, as Figs. 2 or 3, proper means being devised to keep the water out without loss of power.

In order thoroughly to prove my position, and leave nothing untried as far as my means would allow, and so as not to venture before the public unprepared, I fitted out the same model with a pair of side paddles of the best proportions the experience of that day pointed out, Fig. 5; but in order to get a satisfactory trial, so as to make a fair comparison of the merits of the one system with the other, I considered it necessary either to cause the model to run the same distance with both plans each time the spring was wound up, or to so adjust the motion of the machinery and connect it with the shaft of the screw, as also with that of the side paddles, as that the model would be propelled at the *same speed* whether with the one or the other, when the water was perfectly smooth, and no wind to influence the motion of the model.

I determined eventually to carry out the latter idea, viz., to obtain the same speed with both systems, and simple as this may appear, it turned out to be a work of great labour and requiring much perseverance; for each alteration required additional experiments, and as those experiments had to be made when there was no wind and the water perfectly smooth, it necessarily required a considerable time to get anything like the exact speed with both systems; especially as I had no opportunity of making experiments except on an exposed sheet of water, and the slightest breeze or ripple on the surface acted much against the side paddles, while it did not seem in the least degree to affect the action of the screw propellers.

Had this not been the case these experiments would have been anything but encouraging, for when the water was perfectly smooth

Stern view.*



* See larger drawing of propeller, Fig. *d*, page 17.

Stern view.

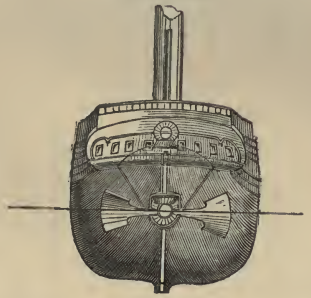


Fig. 4.

Side view.

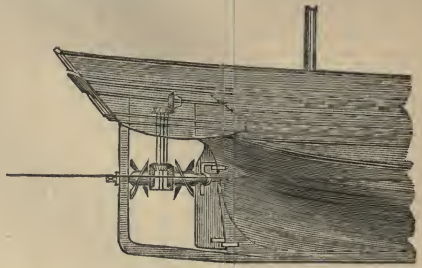
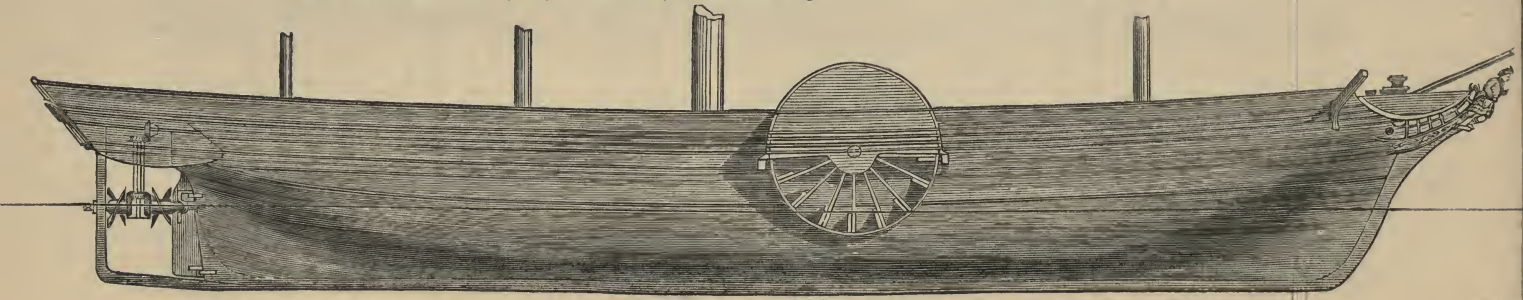


Fig. 5.—Model of 1827 and 1828, made in 1826, about 3 feet long.

Side view.



Scale 1-6th of Model.

the side paddles propelled the model fully one-half farther, or more than one and a half times as far as the screw propellers did, that is for each time the spring was wound up; but when circumstances were changed, and the surface of the water was in the least degree agitated, the speed of the model with the side paddles was not only reduced, but the distance passed over was also much below that travelled with the screw or stern paddles, while the latter in this slightly-agitated state of the water did not appear to be affected either as to speed or distance. When the water was so rough as to act on the model like a storm at sea on a vessel of greater magnitude, the side paddles, either with a side or head sea, were rendered entirely useless, and the model drifted with the wind and waves without making any headway. But with the screw propeller the result was widely different. Even under these circumstances the model was driven more than two-thirds the distance along which it was moved in perfectly smooth water, and with a side sea *or wind upon the beam*, the model with the screw propeller ran nearly the same distance as it did in perfectly smooth water, while with side paddles, under these circumstances, it made no headway at all.*

This was the triumph I expected to obtain, and farther, as the surface of the ocean is seldom what may be termed perfectly smooth, I was convinced that, even in fine weather, the screw propeller would be a match for the side paddles on the open sea.

1827-1828.—The Right Hon. Earl of Lauderdale brings Invention before Government and it is rejected—Invention brought before Dunbar Mechanics' Institution—Noticed in Edinburgh Newspapers, etc.

I have thus traced, down to 1827, the current of my thoughts in regard to the screw propeller, as far as I can recall them to memory. These thoughts, and the multitudinous experiments, to many of which I have alluded, it will be seen occupied more or less attention and labour for nineteen years. Amidst the struggles

* When the side paddles were used, the screw propellers were unshipped, and when the screw propellers were used, the side paddles were unshipped.

and occupation of humble life it was impossible to devote that constant and unceasing attention to my invention which I should have done had my time been more at my own disposal. I had at first pursued the object alone and unknown, but as my ideas began to develop themselves, some gentlemen of influence, who were kind enough to witness many of my experiments, gave me fresh energy by their valued approbation, and I began to realise the importance of the discovery I had made, and to look forward to the thanks I should receive from men of science, if my labours were brought to a practical and successful termination.

In 1827, I was introduced to the late James Hunter, Esq., of Thurston, President of the *Dunbar Mechanics' Institution*, of which I was a member. This gentleman interested himself in everything he considered deserving of encouragement, and in my invention in particular, for he took every opportunity of forwarding my views. By Mr. Hunter, I was introduced to the Earl of Lauderdale, who was supposed to have great influence with the Government and the Lords Commissioners of the Admiralty. After the invention had been fully explained to his Lordship, he requested his son, the Hon. Captain Antony Maitland, then captain of the "Glasgow" frigate, to accompany me with my model to a sheet of water in the neighbourhood, and report the results of the experiments to his Lordship, in order that he might use his influence with the Admiralty, if the invention appeared to be worthy of notice. Sir William Houston, and several of the leading members of the Dunbar Mechanics' Institution, accompanied the Captain. The day was very favourable for the trial, and the merit of the stern paddles or *revolving sculls* (as they were then called) over the side paddles was most apparent, so much so that all present expressed themselves delighted with the results of the experiments, and Captain Maitland, as well as Sir Wm. Houston, promised to give the Earl a full account of what they had seen.

The following morning my attendance was requested at his Lordship's residence, Dunbar House, when he expressed himself highly satisfied with the report, and promised to do all he could with the Government and the Lords of the Admiralty to have the principle tested on a large scale, in order that the merits of the invention might be taken advantage of for the public service. His

Lordship was convinced the invention was worthy of immediate attention and investigation; but, at the same time, for reasons he then gave, he expressed to his son a doubt as to whether all the influence he could bring to bear would be sufficient to move the Lords of the Admiralty to action in the matter. I was, however, sanguine enough to suppose that, as the Earl had taken up the matter warmly, and seemed determined to leave no stone unturned on his part to bring the invention into notice, there was no fear of success; but, to my great astonishment and regret, and in the face of the noble Earl's influence, the Lords of the Admiralty declined even to witness the experiments with my model, or to take any notice whatever of the invention. After this, I determined to make my invention publicly known, for, although many persons had witnessed the experiments with the model, as yet no public notice had been taken of them. However, on the 18th October, 1827, a record was made in the minute-book of the Dunbar Mechanics' Institution, of which the following is an extract:—

"Mr. Robert Watson presented to the meeting two models invented by Mr. Robert Wilson (member of this Institution)—the first, a Horizontal Wind Wheel; *the second, a Model with an Apparatus for Propelling Steam Vessels from the Stern, a kind of Revolving Scull.* By it the vessel goes with greater speed than with side paddles, and produces so little motion of the water as to fit it admirably for canal navigation. About three months ago, this model, with the apparatus attached, was tried on the water in the presence of the Honourable Captain Antony Maitland and Sir William Houston, as well as several leading members of this Institution," etc.

(Signed) WILLIAM ROBERTSON, Secretary.

About the end of the same year, 1827, some of the newspapers adverted to the matter. Thus, the *Edinburgh Mercury* of 29th December, 1827, had this paragraph:—

"*New Invention.*—In our paper of Monday, we mentioned that Mr. Robert Wilson of Dunbar had invented a new method of propelling steam vessels; we have since had the satisfaction of examining the model which he has constructed, and, so far as we are able to judge, we consider it as completely adapted to the objects of the ingenious inventor—particularly that of giving to canals the advantage of steam navigation."

1828-1832.—Experiments before Highland Society of Scotland—Society's Reports, etc.

In 1828, Mr. Hunter, still confident of the importance of the invention, determined to make another effort to have its merits properly tested, and applied to the Highland Society (of which he was a member), to prevail on the Council to order a trial on a large scale, with a view to the application of the principle at least to steam boats on canals.* For this purpose, early in 1828, I was requested to attend at the Society's Rooms in Edinburgh with my model, and to explain the principle to the Sub-Committee appointed, at Mr. Hunter's request, by the Society, to examine the principle and report upon its merits. At that meeting it was arranged that the gentlemen forming the Sub-Committee should accompany me to the *Union Canal*, to witness some experiments, the results of which are detailed in the following report:—

"Extract from Report of the Sub-Committee of the Highland Society of Scotland, in regard to the experiments with the model of Mr. Wilson's steam boat for canal navigation, 4th May, 1828.

"The Sub-Committee report that the paddles or *propellers* of this model of a steam boat (Fig. 5, page 19) were set in motion by means of clock-work, and there were also a pair of side paddles of the common kind, which were also impelled by the same clock-work, to make the experiments comparative. That this machinery moved the stern paddles or '*propellers*' for a space of time sufficient to propel this model nearly 200 yards before the clock-work run out.

"That the experiments were tried on that day three or four times, and proved to the satisfaction of all present that the agitation of the water by this model was much diminished by the propelling power being at the stern instead of the sides of the vessel, and that the stern wheels propelled the model fully half the distance farther than the side wheels did,† and also that the vessel steered most correctly with the stern wheels.‡

"That at a meeting of the Machinery Committee, which was called

* The screw is now extensively used on canals in America, on the Continent, and in England and Scotland.

† It is only right to explain that there was a considerable ripple on the water's surface at the time referred to, which gave the advantage to the screw propellers here mentioned.

‡ The above description is sufficient to show how little the principle was understood; the propellers are called wheels, although they had only two narrow blades about one-eighth of a whole turn of a double screw.

soon after this experiment had been tried, viz., upon the 10th of March, 1828, for the purpose of deliberating upon the merits of this invention of Mr. Wilson's, upon a verbal statement by Mr. Hunter and other members who had witnessed the experiments, the Committee was so impressed with the benefits that might be derived to the public by Mr. Wilson's invention, if found to answer in a corresponding manner when applied to a large vessel, as it had succeeded on the model, that they allowed the sum of £10 towards enabling Mr. Wilson to get paddles or 'propellers' made on a large scale, with corresponding machinery, to be applied to a boat which should be tried in Leith Roads.

"That, accordingly, Mr. Wilson got this machinery made, and applied it to a 25 feet boat (Fig. 6) in Leith; and in April, 1828, most of the Committee, with the addition of Commissioner Ferrier, Vice-Admiral Sir David Milne, and other members of the Society, attended at Leith, and witnessed the experiments by Captain Donaldson Boswell, R.N., Captain Trotter, R.N., Mr. M'Pherson Grant, and Mr. M'Donald, the secretary, with Mr. Wilson and two men to work the machinery, going out from the pier of Leith a considerable way into the Roads, when the experiments appeared perfectly to answer, the boat having been propelled by the application of the paddles or '*propellers*' at the stern with more power than could have been applied by four oars, *or double the manual power*, and which enabled the boat to quarter a very heavy sea, and get through it with more safety and rapidity than would have been possible by means of oars; and this appeared to be chiefly occasioned by the steady and permanent, as well as the powerful, impetus which was given by the paddles or '*propellers*' beyond that which could possibly have been effected by means of oars. The boat, which was also worked by two men who were not at all fresh, having been hard at work all the morning getting it ready, left the pier-head, and, with several gentlemen on board, went to and round

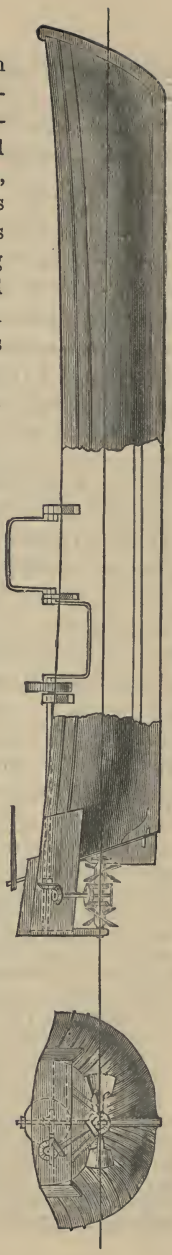


Fig. 6.—Boat and Propellers of 1828.*

* Larger plan of propeller, see Fig. *d*, page 17.

the Martello Tower, and returned again in seventeen and a half minutes, with a very heavy sea, and the wind E.N.E. blowing fresh.*

"Captain Donaldson Boswell, R.N. (who was in the boat during the experiments), considers that the same boat with four oars could not have done the same work in less than half an hour, under the same circumstances." †

"Having perused the foregoing extract from the report of the Sub-Committee of the Highland Society of Scotland respecting Mr. Wilson's model of a steam boat to be propelled by a new principle of paddles or 'propellers,' which is applied at the stern instead of the sides of the vessel; and having attended the two experiments made in presence of a Committee of Directors respecting Mr. Wilson's ingenious plan and principle applied to the stern of the vessel—

"First, the experiments with the model (Fig. 5, p. 19) upon the Union Canal, as herein specified, and afterwards at Leith, for the purpose of witnessing a practical experiment by applying the paddles or 'propellers' at the stern of a large open Boat (Fig. 6, p. 25); and having, moreover, been one of those along with Captains Boswell and Trotter of the Royal Navy, and Mr. M'Pherson Grant, who attended Mr. Wilson in the Boat, I have no hesitation in stating it to have been the opinion of those gentlemen who were in the Boat, but also of many others of the Directors of the Society, who attended on that occasion and witnessed the experiments, that the results of Mr. Wilson's ingenious application of the paddles or 'propellers' at the stern of the Boat, answered our most sanguine expectations. In consequence, the Directors not only sanctioned the purchase from Mr. Wilson of his model, but also authorised that the sum of £10 should be paid to Mr. Wilson, to defray the

* So rough was the sea on the day referred to when the experiments were made, that none of the pilots could be induced to accompany the experimenters with either oars or sails in any of their boats, and fears were even expressed by the gentlemen on board that the boat would not stand the severe action of the waves and return in safety, but the continuous and rapid motion given by the propellers kept the boat not only free from rolling, but also under the most perfect control, which soon satisfied them as to her safety. She obeyed the helm most promptly in every position relative to the wind and waves, which gave me full confidence in the principle as applicable to steam ships exposed to heavy storms at sea.

† These experiments, which were continued about two hours, gave an average speed of about ten miles per hour, without any sensible vibration being felt in the boat from the action of the propellers, either on rough sea outside, or the smooth water within the pier. During subsequent experiments, the distance of five miles was run in twenty-five minutes, being equal to twelve miles per hour. The boat with which these experiments were made was well constructed for fast sailing. With these experiments, there were two propellers with two blades each, Fig. 6, the one propeller immediately behind the other, the centres being in the same line, and the shafts just above the water line.

expenses of the experiments in Leith Roads. Certified and declared at Edinburgh, this 18th day of April, 1832, by

(Signed) "R. MACDONALD,
"Secretary, Highland Society of Scotland."

It may seem strange that these experiments were made at Leith instead of on the Union Canal, seeing that they were for the purpose of showing to the Highland Society the applicability of the principle to canal navigation; but as I was more anxious to show the applicability of the principle to ocean than canal navigation, this arrangement was made through the influence of Mr. Hunter, in order to test the merits of the invention in rough water, and consequently its importance as a means of propulsion for Ships of War and other Ocean Steamers.

On the day following that on which I attended at the Society's Rooms, Edinburgh, I was requested to wait upon Mr. Waddell of Leith Links, who had made a number of experiments with a propeller which was considered by some of the gentlemen present at the experiments with my model on the Canal to be on the same principle as that of my propellers, but a single glance was sufficient to show the difference, as Mr. Waddell's partook of nothing of the principle of the screw, the blades being mere flat surfaces set at an angle. A single trial with Mr. Waddell's model against mine, was quite enough to show the gentlemen present the superiority of the latter; for, although the amount of moving power was the same in both models, my model ran double the distance of the other for each winding up of the spring, and that in the same time.

At the conclusion of the above Report it is stated that, besides the purchase of the model, I was to receive £10 to defray the expenses of the experiments; but, whether owing to a rule of the Society, or whether it was considered by the Society as giving encouragement to a project that did not fall within the Society's authorised sphere of action (although Canal navigation might well be considered within that sphere), certain it is that a necessary condition to my receiving the £10 for expenses was the giving up of my model to the Society. This I did, but with the greatest possible reluctance, as it had cost me much anxiety and labour. I had, however, no alternative between doing this or what I dreaded still more, getting into debt. Not a hint had been given previously

to the conclusion of the experiments as to my having to give up my model, and I felt astonished and deeply grieved that I had to do so. For, besides my travelling and other expenses, the experiments had cost me upwards of £20, and the model was worth about £20 more. While I mention these facts, it will be understood that I do not attach any blame to the Society. It was unfortunate that I had to resign the model, but this does not diminish in any degree the credit due to the gentlemen who took so great an interest in my views, and who put themselves to so much personal trouble to forward them. Indeed, it is not at all unlikely that they were not aware I should be required to deliver up the model to the Society. However, as a set-off to my loss, and to the great discouragement I then felt, I now look back to the experiments at Leith in 1828 with any feeling rather than that of repining. To them I am inclined to attribute much of my after success in mechanical pursuits. The first step to my present position may be said to have been taken at the time of making the experiments at Leith; for I then met with a number of scientific gentlemen, who took great interest in my invention of the screw propeller, and who strongly advised me to persevere, as in their opinion my invention would be of great importance for ocean steamers and ships of war, and they used all the influence in their power to have its merits tested on a larger scale; but no ship builder or man of capital could be found who would run that risk, which was thought should be undertaken by Government, and, consequently, for want of sufficient capital, it had to be laid aside until 1832.

1832-1833.—Invention brought before Society of Arts—Their Report of Experiments at Sea, etc.

From what has just been stated respecting my position after the experiments made for the Highland Society in 1828, it will not surprise anyone to learn that, for the next two or three years, little was done by me with respect to my invention; for, although various applications were made to me during that time, with the view of applying the new propeller on a still larger scale, none of

the applicants would undertake to bear the expenses of an outfit; and not being myself in a position to make a second contract on the same conditions as before, I was obliged to take advantage of the lesson I had learned by experience, and wait with patience till a better opportunity presented itself.

In 1832, Mr. Hunter, still confident of success, brought the subject of the screw propeller before the Society of Arts in Edinburgh; and, that that object might be the more easily attained, a copy of the Highland Society's Report of my experiments was obtained, with the Secretary's certificate affixed. This certificate is dated 18th day of April, 1832, but the report, as has been already stated, bears date 4th May, 1828.

The following extracts from the minutes of the Royal Scottish Society of Arts, sufficiently explain with what spirit this Society took up the subject, carried out the experiments, and endeavoured to bring my invention into practical operation :—

"Excerpt from the Minutes of the Society of Arts for Scotland, dated May 2, 1832.

"Description and Drawings of 'Stern Paddles' for propelling Steam Vessels, etc., by Robert Wilson, Engineer, 15 North Back of Canongate, Edinburgh, were read and exhibited.

"These paddles work at the stern in place of the sides of the boat, and act on the principle of sculling.*

"A pair of Paddles were exhibited.

"The Society were pleased with the ingenuity displayed in the construction of these paddles; but before expressing a decided opinion on their merits, they resolved that a comparative trial of these paddles and of side paddles of the common kind should be made, by having them fitted to a boat.

"The following Committee was appointed to conduct the experiment, and defray the expenses of it, and to report at the General Meeting in June: viz., Sir Thomas Dick Lauder, Bart., Vice-President, Mr. Hunter, of Thurston, Mr. Crawfurd, of Cartsburn, Vice-Admiral Sir David Milne, Captain Watson, R.N., Mr. Whytock, Mr. Tod, Secretary, and Robert Stevenson, Esq., Civil Engineer, Vice-President, Convener.

* It is worthy of notice that the name of "Screw" had not then been given to this propeller. The writer's first ideas of this propeller being, as before stated, taken from the sculling oar, (and that being well-known at the time these experiments were made,) will account for what is said above respecting the principle being that of "Sculling."

"Report of the Committee of the Society of Arts for Scotland, appointed on 2nd May last to experiment with Mr. Robt. Wilson's '*Stern Paddles.*'

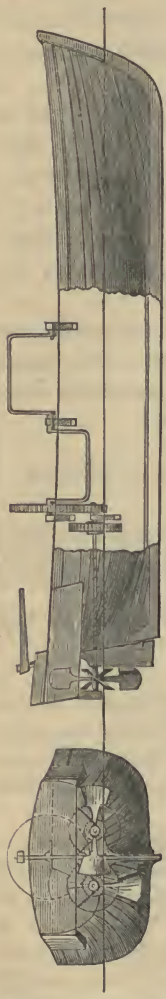


Fig. 7.—Boat and Propellers of 1832.*

"Your Committee beg leave to report that a pair of Stern Paddles of the most approved construction, (viz., those revolving on separate axles and in opposite directions in the same plane,†) were by their orders fitted to a Boat kindly lent to Mr. Wilson by Mr. Sim, ship-builder, Leith, the Boat being 18 feet long and 7 feet broad, by no means well constructed for fast sailing. (Fig. 7.)

"The Committee intended also, if there had been sufficient time, to have ordered a pair of common side paddles to be attached to the same boat, so that a comparative trial might have been made, but from want of time this became impossible. The Committee were also at considerable loss what directions they should have given in regard to the diameter and breadth of such side paddles, even if there had been time for their construction; as they understood that side paddles on the small scale have never been found to answer, from the circumstance of their merely skimming the surface of the water, and not going deep enough to get a solid body to act upon.

"If the Society still wish this comparative trial to be made on the small scale the Committee will attend to their instructions, and will take the best scientific assistance in regard to the proper diameter and breadth of the side paddles. But as they are of opinion that any comparative trial between the stern and side paddles on the small scale would be very unfavourable to the latter, for the reason above assigned, they shall, in the meantime, report the results of their experiments with the stern paddles alone; leaving it for the Society to judge of their efficiency, and to consider whether it would be advisable or not to have side paddles constructed, and a comparative experiment still made, remarking at the same time, that the result can hardly be taken as a fair estimate of the speed at which the boat might have been

* Larger plan of propeller, see page 17, Fig. *d*.

† This plan of arrangement was afterwards, in the year 1851, patented by a Mr. Taylor.

propelled, had the circumstances been more favourable, inasmuch as, from the size and shape of the boat, the number of persons aboard, and the position of the men working the cranks, the machinery was heavy to work, soon tired the men, and occasioned them often to change, which caused the boat to roll, and put her frequently out of trim.

"Notwithstanding these unfavourable circumstances, however, the Committee were highly gratified with the results of their experiments. The boat obeyed the helm most promptly, as well in rough as in smooth water, and nothing seemed to be wanting but a steady and sustained power, such as the steam engine, to produce the requisite velocity; and the Committee are satisfied that if stern paddles on a large scale shall be found to be as efficient in proportion as they are on the small scale, (which the Committee see no reason to doubt,) they will speedily be adopted in situations where *side* paddles could not be applied, from the advantages they possess over the latter in many points of view, particularly in their creating no agitation in the water that could be hurtful to the banks of canals, in their working equally well in a rough as in a smooth sea, which way soever the wind may blow, in their requiring no flattening on the sides of the Boat, nor cumbrous paddle boxes attached to the sides of the vessel, which are so disadvantageous to a sea Boat, and their being easily unshipped when necessary, either for repairs or (in the event of their being attached to Ships of War) when the use of them is not required.

"The Committee would therefore humbly suggest that the Society should endeavour if possible to get a trial made of these stern paddles on a *large scale*, and their results compared with those of *large side paddles*, and from the simplicity of their construction, this could not be attended with much expense; but as the funds of the Society are inadequate to the attainment of this object, the Society should give a strong recommendation of the principle upon which Mr. Wilson's stern paddles are constructed, which may be the means of bringing this invention under the notice and consideration of the Lords of the Admiralty, who may in all probability be disposed to give it a trial on the large scale; considering, that if successful, its application to Ships of War, as well as Merchant Ships, from its capability of being placed *altogether under water* (where in fact its propelling power would be still greater than in your Committee's experiments, where the one-half only was immersed,) and *out of the reach of shot*, will at once be admitted to be a matter of the greatest importance. All of which is humbly reported by

(Signed) "THOMAS DICK LAUDER.
"WILLIAM CRAWFORD.
"JAMES TOD, Secy., Convener,
"in absence of Robert Stevenson, Esq.

"*Edinburgh*, 18*th June*, 1832."

"What is written on these seven pages are true excerpts from Minutes and copy Report of the Committee of the Society of Arts, read and approved of.

(Signed) "JAMES TOD, Secy., S. A.

"*20th June*, 1832,"

To this may be appended an

"Extract from Report of the Prize Committee of the Society of Arts, Scotland, dated 6th October, 1832.

"To Mr. Robert Wilson, Engineer, 15 North Back of Canongate, Edinburgh, for his Description, Drawing and Model of Stern Paddles for propelling Steam Boats, etc., invented by him; read 2nd May, 1832, and experiments made at Leith with a boat fitted up with these Stern Paddles, on the 7th and 18th June, 1832—the Society's Silver Medal, value 'Five Sovereigns.'

"Upon this interesting and very important subject the Committee, to whom this invention was referred, made very accurate experiments with the stern paddles at considerable expense to the Society; and from their report it appears that these paddles possess, in many respects *manifest advantages over the common side paddles, and could be easily adapted, not only to merchant ships, canal boats, and steam boats generally, but also to ships of war. They can be kept altogether under water and out of the reach of shot, and answer equally well in rough as in smooth sea.*

"*N.B.*—The above report was read, and the prize was delivered to Mr. Wilson at the Annual General Meeting, on the 12th December, 1832.

(Signed) "JAMES TOD, Secy."

COPY OF MEDAL.

1833-1836.—Scottish Society of Arts bring Invention before Admiralty—Again rejected—Official Report of Officers of Woolwich Dockyard—Correspondence—Duke of Richmond's Letter—Mr. Smith Patents same Invention—Contrast.

The great interest taken in my invention by many noblemen and gentlemen about this time (1833-36), will appear from the following correspondence, which also shows the manner in which it was rejected by the Government:—

Letter I.—Sir John Sinclair, Bart., to James Tod, Esq., Secretary of the Royal Scottish Society of Arts, dated 16th January, 1833.

Sir,

I think it would be very desirable to bring the plan for improving the construction of Steam Vessels under the consideration of the Board of Admiralty; and I applied to Sir James Graham to know what would be the best mode of having that object effected. I enclose Sir James' answer, and shall have much pleasure in sending to Captain The Hon. George Elliot any account of the plans which the inventor may wish to submit to the consideration of the Admiralty Board.

I shall be glad to have the pleasure of seeing you, or the inventor, on the subject, on Friday or Saturday morning, at eleven o'clock.

I remain, etc.,

(Signed) JOHN SINCLAIR.

Letter II.—James Tod, Esq., Secretary, Scottish Society of Arts, to Sir John Sinclair, Bart., dated 17th January, 1833.

Sir,

I had the honour to receive your obliging communication of yesterday's date, and will have great pleasure in attending at your house on Saturday forenoon, at eleven.

I have written to the inventor of the *stern paddles*, Mr. Wilson, to attend on that occasion.

He is a very intelligent man, and I am sure the Society wish him every success in his endeavour to accomplish the introduction of this improvement both in the Royal and Mercantile Navy, the first desideratum being an experiment on the *large scale*, which can only be done under the auspices of Government.

I have also asked the attendance of Mr. James Simpson, advocate,* who has all along taken Mr. Wilson by the hand, and who had a conversation with me only two days ago about forwarding a communication to Captain The Hon. George Elliot, Secretary to the Admiralty, who I heard was lately in Edinburgh, and may not yet have left the city.

I have the honour, etc.,

(Signed) JAMES TOD.

LETTER III.—Mr. TOD to Sir THOMAS DICK LAUDER, Bart., dated 24th January, 1833.

SIR,

Sir John Sinclair has been corresponding with the Admiralty as to the best mode of bringing "Wilson's *Stern Paddles*" before their Lordships' notice.

Mr. Wilson, Mr. Simpson, advocate, and I, had a meeting with Sir John upon the subject, when Mr. Simpson proposed, as the best way of managing the matter, that a recommendatory letter should be prepared, to be forwarded to Captain the Hon. George Elliot, Secretary to the Admiralty, by the Solicitor-General, who, it seems, undertook to do so after Wilson's invention should receive the sanction of the Society of Arts, and that this letter should be signed by you as Convener of the Experimenting Committee, as also by Sir David Milne, Sir John Sinclair, the Solicitor-General, and any other influential person acquainted with the subject.

That this letter, together with copies of the papers read before the Society, with relative drawings, and the Report of the Committee, should be transmitted to Captain Elliot, Secretary of the Admiralty, with a private letter of recommendation from the Solicitor-General.†

In order, therefore, to expedite the matter, and if it is not putting you to too much inconvenience, Mr. Simpson and I would be glad if you could meet us in the *Parliament House*, either on *Saturday* or *Tuesday*, at eleven o'clock, as may best suit you, to converse over the

* I think it due to the memory of Mr. Simpson to say that he was one of the best and most constant friends I ever had. His interest in my invention remained unabated until his death, and shortly before he died he expressed his deep regret that the importance of my invention had not been more fully recognised.

† At Mr. Simpson's suggestion, the propeller and machinery with which the experiments were made in Leith Roads were also sent, in order that their Lordships might have an opportunity of testing the principle without loss of time, before proceeding with the experiments on a larger scale with steam power.

business, and endeavour to see the Solicitor-General, and get him to lend a helping hand. The papers are in progress of being copied and nice plans drawn.

Will you be kind enough to drop me a penny post note in course of to-morrow, fixing your day, as I must let Mr. Simpson know to make sure of a meeting.

I am, etc.,

(Signed) JAMES TOD, Secy.

P.S.—This evening's post has brought me a letter from Sir John Sinclair, enclosing one from the Duke of Richmond, who I observe declines to comply with Sir John's request, which I presume was to try the experiment on one of the Government post office packets, for the obvious reason, as the Duke says, that if the experiment should fail, the consequent delay would be a serious inconvenience to the public.

LETTER IV.—The DUKE OF RICHMOND to Sir JOHN SINCLAIR.

22*nd January*, 1833.

SIR,

I beg to acknowledge the receipt of your letter of the 16th inst. I regret that it is not in my power to comply with your request. The regulations of the department do not permit me to make experiments in the packets, for the obvious reason, that, if the invention should fail, the consequent delay would be a serious inconvenience to the public.

I have the honour, etc.

(Signed) RICHMOND.

In consequence of the Society of Arts having, in the last quoted report, given "*a strong recommendation*" of the invention, in order to bring it under the "consideration of the Lords of the Admiralty," because if "successful its application to Ships of War as well as Merchant Ships would at once be admitted to be a matter of the greatest importance,"* the reports detailing the Society's experiments at Leith Roads, and a recommendation of the invention as one of great importance, together with the propellers, machinery, etc., were transmitted to the Lords of the Admiralty, requesting their Lordships to try the invention on a large scale.

In a letter to me on this matter, the Secretary of the Society writes:—"To the Society it seemed self-evident that, from the

* Excerpt from Letter by Mr. Tod.

machinery being out of the range of shot, the invention was particularly desirable for the Navy, so that the trial the Society recommended was to find the degree of *speed* which could be attained by the Screw or Stern Paddles." Notwithstanding this, the application to the Admiralty was unattended by any favourable results, as the following letter and report will show :—

Letter accompanying the Report of the Officers of Woolwich Yard.

ADMIRALTY, 18*th September*, 1833.

SIR,

My Lords Commissioners of the Admiralty having referred to the Officers of Woolwich Yard the papers (returned herewith) respecting Mr. Wilson's invention for propelling steam boats, I am commanded by their Lordships to transmit to you, for your information, a copy of their report thereon.*

I am, etc.,

(Signed H. F. AMEDROZ, pro Secretary.

Vice-Admiral the Hon. C. E. FLEMING.

Report referred to—

WOOLWICH YARD, 17*th September*, 1833.

SIR,

In pursuance of your directions by Minute of the 10th on the Honourable Captain Elliot's letter of the 9th instant, we are to acquaint you that we have carefully examined the papers therewith transmitted, in conjunction with Messrs. Lloyd† and Kingston, who concur with us in the opinion, that the plan proposed (independent of practical difficulties) is objectionable, *as it involves a greater loss of power than the common mode of applying the wheels to the side*, and herewith return the papers.

We are, etc.,

(Signed) OLIVER LANG.
R. ABETHELL.

Captain Superintendent WARREN, C.B.

This Report will surprise many, when it is considered that along with the Report of the Society of Arts there were sent to the Ad-

* As far as can be ascertained, neither the propellers nor machinery were returned with the papers here referred to. It would be interesting to know what became of them, so as to judge of the opportunity afforded to others to improve upon them.

† This gentleman is, I presume, the "Mr. T. Lloyd" who reports favourably of the screw in 1840, as mentioned at page 9.

miralty full particulars of the practical experiments just referred to, as well as the identical propellers and machinery with which those experiments were made in Leith Roads. The unfavourable reception the invention met with from the Admiralty had the unfortunate effect not only of delaying for years the introduction of the screw propeller into the Royal Navy, but it also deprived me of the co-operation of the noblemen and gentlemen who had until then actively countenanced me. Seeing no prospect of bringing the invention to a practical development for the benefit of the country by a trial on a large scale, they gave up the subject in despair, expressing great regret and disappointment that their influence and trouble had been spent in vain, and that the public service had been deprived of the use and benefit of a valuable invention. This was a very painful discouragement to me, although I could not believe that the Dockyard Reporters would succeed in finally consigning the invention to obscurity, after it had been so often approved of by men of skill. I considered not only that the screw would be valuable in Ships of War and Merchantmen, but also in many other ways. Thus, a boat for embarking or disembarking troops, if fitted with screw propellers, would possess several advantages over a boat with oars; inasmuch as it could be brought close alongside a vessel or landing-place with the propellers in action; and as the propellers could be worked by the troops during their transit, the sailors in charge would be fresh for returning quickly for another detachment. Less room would be required for working the propellers by manual power than is required with the common oars, and therefore a boat could accommodate a greater number of soldiers. Again, owing to the screw working as well in rough as in fine weather, I considered it well adapted for life-boats, often exposed as they are to waves against which oars are of little avail, and they could be constructed so as to be propelled either in one direction or the other, the propellers all the while being quite protected from accident. These considerations determined me to wait with patience for an opportunity of getting some shipbuilder or other enterprising person to take up the matter, and meantime to endeavour to save something to aid still further in bringing the invention before the public.

All my calculations of usefulness in regard to the screw were,

however, suddenly superseded on hearing, some time about 1836, that a Mr. Smith had not only made the same discovery as myself, but had actually taken out a patent for it. I thereupon gave up the matter in great disappointment, and under a feeling, which has grown stronger with time, that I had not been fairly used by the Admiralty Reporters in regard to my invention.

It may not be uninteresting briefly to glance at the rise and success of Mr. Smith's invention of the screw propeller, or rather of his "*improved propeller*," as he termed it, as he does not seem to have claimed the merit of originating it. In 1835, Mr. Smith, then a farmer at Hendon, had his attention first directed to the subject of screw propulsion; in the spring of 1836, he obtained the co-operation of a Mr. Wright, a banker, and a patent was granted to Mr. Smith, on 31st May, 1836, for his "improved" screw propeller, which consisted of two entire turns of a single threaded screw. A model boat which he had constructed, and which was fitted with a wooden screw driven by a spring, was then exhibited in operation upon a pond on his farm at Hendon, and at the Adelaide Gallery in London. The results obtained with the model were so satisfactory that, in the autumn of the same year Mr. Smith and his friends constructed a boat of six tons burthen, and about six horse-power. On 1st November, 1836, she was exhibited to the public, in operation, on the Paddington Canal, and she plied there, and on the Thames, until September, 1837. During one of the trips on the Paddington Canal, in February, 1837, an *accident* occurred which first pointed out the advantage of diminishing the length of the screw. The propeller having come in contact with some object in the water, about one-half of its length was broken away, and no sooner had this occurred, than the boat quickened her speed and was found to realise a better performance than before. In consequence of this accidental discovery, a new screw was fitted, having a single turn, and the results were very satisfactory. To show that his screw was suitable for sea voyages, Mr. Smith, in September, 1837, went in his experimental boat from Blackwall to Ramsgate, and thence to Dover and other places. In March, 1838, the screw was tried before the Admiralty. After several trials, in May, 1839, before Captain Crispin, Admiral Fleming, and others, with Mr. Smith's

larger vessel, the "Archimedes," (which cost him and his friends £10,500,)* against a Government vessel, and after numerous other trials both at home and abroad, and when the advantages of the screw over the paddle wheel were rendered obvious to everyone, the Admiralty determined to try the screw, and the "Rattler" was, in 1841, begun for the Navy. In 1845, when the Steam Navy was about to be considerably increased, the Board of the Steam Department, Somerset House, "determined that the screw should be adopted," and thus Mr. Smith obtained a world-wide renown as having firmly established the principle of the screw propeller in Great Britain,† as Captain Ericsson did in America.

* In the *London Mechanics' Magazine*, No. 830, it is stated, "The *Archimedes* was built *by a company* for the purpose of testing the Invention, and we believe the CHIEF PROMOTERS to be the *Messrs. Rennie* and *Messrs. Wright* the Bankers."

† In a printed pamphlet now before me, three Irvine gentlemen, Messrs. Steedman, M'Cririck, and Dick, are said to be entitled to the honour of suggesting the screw propeller to Mr. Smith. Mr. Steedman having noticed a resemblance between "the fish tail and scull," made the discovery of the screw in a "*deep ditch*" near Irvine, a *stob* being used for a vessel, and the *wand of a mole-trap* for the motive power. In 1829, this invention was brought before the Royal Society of Edinburgh, and in 1830, before the Royal Society of London. From these learned Societies, however, *the pamphlet states*, "repeated discouragements were obtained." Some persons will therefore at a first glance assume that the only original things connected with the invention were the instruments with which it was first tried, and that these were not likely to be pirated by anyone; but an attentive perusal of this pamphlet (published in 1858), which is written with considerable ability, will perhaps incline them to a different opinion. The gist of the pamphlet may thus be summed up: 1. That Mr. Smith was incapable of inventing the propeller; 2. That the propeller he patented was truly the Irvine one, which had been appropriated by an engineer to whom it had been entrusted, he patenting the Invention in the name of Francis Pettit Smith. The pamphlet thus speaks of Mr. F. P. Smith's persistency as regards the introduction of the screw:—"With all his 'persistency' he never made any great personal sacrifice, and never had much at stake in the great adventures with which his name is identified. The whole secret of his 'persistency' is contained in one sentence of Mr. Bourne's, when acknowledging the services of Smith's coadjutors—'first amongst these auxiliaries must be mentioned Mr. Wright, the banker, but for whose aid Smith's patent would perhaps never have been taken out.'"

CONCLUDING REMARKS.

Captain Ericsson's Invention, etc.

These sketches of my efforts to introduce the screw propeller and render it useful to my country, and the statements* concerning Mr. Smith, suggest, without the smallest disparagement to that gentleman, a somewhat startling contrast.

I, a *mere boy* and afterwards a working lad, first take up the idea of the screw propeller in 1808; Mr. Smith, a grazing farmer (born 1808), does so in 1834. The invention costs me, ere its last rejection by Government, some twenty-five years more or less of labour, privation, and anxiety; Mr. Smith in a very short time finds a friend in Mr. Wright, and, in 1845, his improved propeller† is finally adopted in the Navy, and becomes common

* These Statements are taken from the very able work on the screw propeller by John Bourne, Esq., C.E.

† Perhaps I may rather say *my* propeller, for Mr. Smith had now come, step by step, to the identical propeller I used in 1826. His propeller was reduced, from time to time, from two whole turns of a single-threaded screw, patented in 1836, to one-sixth of a turn of a double-threaded screw, ere it was adopted in 1845; which I had found to be the *maximum* breadth for advantage by my experiments in 1826, nineteen years before. See page 17.

No. 1. No. 1.

No. 1—A screw of two turns, patented by Mr. F. P. Smith. Patent granted on 31st May, 1836, and applied to a boat about 10 tons burden and about 6 horse-power.

No. 2. No. 2.

No. 2.—A screw of one turn as pointed out *by accident* to be preferable to two turns, as No. 1. in 1837, and fitted to the "Archimedes" in 1839.

No. 3. No. 3.

No. 3.—A double-threaded screw of half a turn, fitted to the "Archimedes" in 1840, and fitted to the "Rattler" in 1843.

No. 4. No. 4.

No. 4.—A double-threaded screw of a fourth of a turn, tried on the "Rattler," from 1843, with other forms, to 1845.

No. 5. No. 5.

No. 5.—A double-threaded screw of a sixth of a turn, adopted in 1845 after many experiments with the "Rattler," but which was also experimented with by the writer in 1826 to 1832, and with less portions of a turn. See page 16.

in the merchant service. I, backed by the best influence in Scotland, for the second time, offer the invention, gratuitously, to the Admiralty in 1833, and it is rejected as inferior to side paddles: Mr. Smith, secured by a patent, and backed by rich and enterprising commercial men, and by public opinion, brings the matter as a commercial speculation before the Admiralty in 1838, and three years later the Government are building screw ships. I make (passing over all preliminary experiments on lakes) a trial of the screw in a twenty-five feet boat, in 1828, in the open sea, in presence of Vice-Admiral Sir David Milne and many other official gentlemen, and in a sea so rough and dangerous that none of the pilots at Leith would accompany the experimenters. In September, in 1837, Mr. Smith (keeping lake and canal experiments out of view) tests his six ton boat at sea; and finally, in 1845, twelve years after finally rejecting the screw propeller at my hands, the Government accept and "adopt" it at Mr. Smith's.

Having now completed the evidence I have to offer as regards my claim to the invention of the screw propeller, as adapted to Ocean Navigation, I believe impartial readers will conclude that I have clearly proved that the screw propeller might have been introduced into the Navy in 1827 or at least as early as 1833, and that its not being so was owing not to any want of steady perseverance and effort on my part, backed by the influence and intelligence of the Royal Scottish Society of Arts, and several eminent men, but solely in consequence of an unfortunate error in judgment on the part of the then officers of the Woolwich Dockyard—in rejecting all recommendations to adopt the screw without so much as putting the invention to a test—and then issuing a report *which all subsequent experience has shown to be entirely erroneous.* I readily acquit the then Lords of the Admiralty of any blame in this matter. Their Lordships, doubtless, placed implicit confidence in the scientific knowledge and industry of the officers of the Dockyard, and were warranted in abiding by their report; but it is not the less evident that this report caused me to suffer, at the hands of the Government, almost irreparable injury and injustice. Had the invention been carefully scrutinised by those to whom it was referred, or had they understood the principles involved, they could not have reported upon it as

"objectionable," and "as involving a greater loss of power than the common mode of applying the wheels to the side." On the contrary, is it too much to say, that, had the representations of noblemen and others, whose statements were beyond question, been listened to, a trial of the screw on a large scale would have been immediately ordered, and Government would have been building many vessels fitted with the screw, before Mr. Smith (who afterwards carried off all the honours and rewards of the invention) had even his attention directed to the matter in 1835? It is curious to note the influence which time—the refuter of errors —has had upon the minds of gentlemen who at first were foremost in opposing the introduction of the screw propeller, and who seem actually to have forgotten having offered such opposition. Thus, on the list of Mr. F. P. Smith's Testimonial, published in 1856, is to be found the name of at least one eminent engineer, who, little more than twenty years before, took an active part *as opponent* in a discussion on the merits of the principle of the screw propeller as compared with that of the side paddles, and lectured against it to the pupils of his mechanical class as a most absurd idea. That same gentleman is now (I may presume) an admirer of the principle he formerly condemned, since he is not only one of the most liberal subscribers on that list, but took an active part in obtaining subscriptions from others. Again, *at the very head of this list*, is the name of another admirer of the principle of the screw propeller, whose name, in 1833, appeared at the end of the Report of the officers of Woolwich Dockyard; and further, there is to be found on that list the name of another eminent engineer, of whom it is said, that, "after making a number of experiments, *at the command of the Lords of the Admiralty*, with screw propellers and side paddles, in order to determine which was the most suitable for Her Majesty's Navy, he gave such a favourable report of the advantages of the screw propeller compared with the side paddles, that their Lordships were induced at once to make arrangements for its adoption in Her Majesty's Navy;" and yet, strange to say, this gentleman's name is also in the Report of 1833, condemning the screw as inferior to side paddles. The actings of these gentlemen, who thus, in 1833, condemned my screw propeller without a trial (though the machinery and propellers, with the

papers before referred to, had been sent to enable them to judge of it); but, when its advantages could no longer be denied, showed themselves so eager to testify their approval of it, is a curious illustration of the experiences of inventors. Had the gentlemen not been themselves professedly scientific men, and had my invention come to them as a *mere* theoretic effusion of a dreamy imagination, unsupported and untried, then their rejection of it might have been less surprising; as the principle and advantages of the screw propeller were not fully understood, nor was it seen by many to be a desideratum for our Navy and other ocean steamers. Moreover, it is proverbial that the most important inventions have been at first scoffed at, and the inventors treated with ridicule. Take for an illustration the case of Mr. George Stephenson, whose theory of railway travelling was energetically opposed by the engineering world. The *Quarterly Review* for March, 1825, says: "What can be more palpably absurd and ridiculous than the prospect held out, of locomotives travelling *twice as fast* as stage coaches. We should as soon expect the people of Woolwich to suffer themselves to be fired off upon one of Congreve's ricochet rockets, as trust themselves to the mercy of such a machine going at such a rate. We will back old Father Thames against the Woolwich Railway for any sum." Again, Mr. William Brougham (retained by the promoters of a railway to carry the bill through Parliament) frankly told Stephenson, who spoke of being able to impel his locomotive at twenty miles an hour, that if he did not moderate his views, and bring his engine within a *reasonable* speed he would "inevitably damn the whole thing, and be himself regarded *as a maniac fit for Bedlam.*" If such a man as Stephenson was misunderstood and his statements doubted, I repeat, the officers of Woolwich Dockyard might have been justified in refusing to listen to a mere theory propounded by an unknown youth. But how different was their position! They had referred to them, by the Lords Commissioners of the Admiralty, the particulars of an invention which had been *actually tested on the open sea, and had been declared by the Committee appointed by the Scottish Society of Arts, on the strength of personal observation, "to possess manifest advantages over the common side paddles, and which might be easily adapted to merchant ships and ships of war.*" They had the very apparatus sent to them

with which they could have put the invention to the test, and yet they did not try it, but on the contrary summarily rejected it for an *assigned* reason, which all subsequent experience has proved to be totally untenable, and thus deprived the Government of an opportunity of obtaining a valuable invention *gratuitously, and of saving millions of the public money.** I do not wish, however, to reflect even on the officers of the Woolwich Dockyard. I can only regret that they had not acted otherwise.

Some persons may say, Why did I not secure a patent! To this I answer, that my means were inadequate, and I had no friends who could assist me to procure one; and moreover, although I had had opportunities of doing this, such an idea would probably not have occurred to me, as I had no selfish object in view. Besides this, I had not kept my invention secret. I knew it was valuable, and what I most desired was, to make it useful to my fellow-men. Nor is it by any means certain, though I had secured a patent, that this would have led to the adoption of the screw by Government. I might have shared the fate of Captain Ericsson in England, without obtaining the ultimate success which fell to his lot in a foreign land. This accomplished mechanician took out a patent for the screw propeller in July, 1836—little more than a month after Smith. In 1837, he exhibited his vessel to the Lords of the Admiralty, and towed the barge in which they were seated at the rate of ten miles an hour, and yet, notwithstanding this success, Captain Ericsson, from some "inscrutable reason," received no encouragement from the Admiralty. He went to America in disgust. His propeller was introduced into the United States Navy, and hundreds of vessels in America are now propelled by the screw—his propeller being still taken as the type which has been almost universally followed in America. The French nation also encouraged him; the Admiralty of England at last, seven years after rejecting his invention, (and after America and France had pronounced it a valuable one,) gave an order for the fitting up of the "Amphion" *frigate with his propeller.* Capt. Ericsson at length discovered that the "inscrutable reason" lay in an idea taken up by the Surveyor of the Navy that,† *as the pro-*

* See Appendix, page 53.

† The same objection as was stated to Mr. Wilson in 1833.

*pelling power was applied at the stern, the vessel could not be steered in an efficient manner.** I repeat, therefore, that even though I had obtained a patent, some inscrutable reason might have rendered the fruit of it only the ruin of some over-confident friend. May not my own experience, and occasional paragraphs in newspapers, suggest the fear that many a promising inventor may be unable to realise his plans from want of the means to bring them forward, or owing to the incredulity of those to whom his invention may have been submitted, and that thus the public may be deprived of benefits which otherwise might have been enjoyed? The great reduction in the price of patents has to some extent removed a stumbling-block which formerly lay in the path of inventors; but if unable, or unwilling to turn his discovery into a commercial speculation, by patenting it, the career of an inventor is far from an enticing one. He has to pass, at first, through the trying ordeal of being looked upon as a visionary and a dreamer; he lives for a time surrounded, as it were, by an atmosphere of—as Thomas Carlyle would say—"deaf, dead, infinite injustice," conscious in his own mind that he is right, but supposed by everybody to be wrong; he has to bear up against the indifference of the learned, and the ridicule of the ignorant; or if, perchance, he happens to meet as I did with the encouragement of those who can rise superior to stereotyped opinions, all his efforts may yet, after the labour and anxieties of many years, end in disappointment, and he may live to see the rejectors of his invention, when it is again offered by another, roused from their indifference by the voice of public opinion, and become suddenly enthusiastic in doing honour to a discovery which years before they had cast carelessly away.

If this paper has the effect of teaching caution in the rejection of inventions—of bringing before the Lords of the Admiralty, and the public, the efforts of the Royal Scottish Society of Arts, the Highland Society, and the Noblemen and Gentlemen above alluded to, together with my own humble endeavours to introduce the screw propeller to the public service, and if, moreover, it throws

* This was in the summer of 1837. In September, 1837, Smith, (to use the telling words of Mr. Bourne,) carried *his* vessel to sea, and *showed, by repeated experiments*, that the objections said to have been entertained in the case of Ericsson's plan did not at all events exist in his. Of course it did not, nor in the more efficient vessel of Ericsson's.

any new light on the earlier history of the invention—then my purpose in writing it is served. I have sought only to establish *facts*. If any of the statements I have advanced can be refuted, I invite such refutation; because, though the rise of screw propulsion has several times been written of, yet, in the word of an illustrious author, "Truth being the legitimate object of history, I hold it better that she should be sought after by many than by few, lest for want of seekers, amongst the mists of prejudice, and the false lights of interest, she be lost altogether."

ROBERT WILSON.

Model Steamer.

By this morning's post (17th May, 1860) I received a letter from the Secretary of the Highland and Agricultural Society of Scotland, Edinburgh, as follows:—

"Highland Agricultural Society of Scotland,
"6 Albany Place, 16*th May*, 1860.

"Dear Sir,

"I am happy to say that I have suceeded in recovering the model of your screw steamer. It is now in my possession and can be inspected by any person who wishes to do so on your behalf.

"I am, etc.,

(Signed) "J. HALL MAXWELL."

The model referred to above is the one represented at page 19, Fig. 5, and referred to in the Highland Society's Report, page 24, and was lodged in their Museum immediately after the experiments at Leith in April, 1828. Some years after this the Museum took fire, and it was supposed this model had been destroyed with a great number of others, but it was only slightly injured, and after being repaired was placed in the Museum again, but when sought for in 1860, to refer to, it could not be found. But some time afterwards it was accidentally discovered, and so pleased was Mr. Hall Maxwell by the recovery that he wrote me immediately as above.

On learning that all the models had been given over to the Edinburgh Museum, I went to enquire if my model steamer had got there with the others; but it had not, and I could get no

account of it anywhere. Professor Archer, the able Director of the Edinburgh Museum of Science and Art, was most anxious for its recovery, and at last, after all hopes were given up, it was found under the cellar stairs of the Highland Society's new offices. It was then nearly a perfect wreck,—all the machinery gone, as well as the propellers; but it will no doubt be again repaired, and take its proper place in the Edinburgh Museum of Science and Art, as an object of interest.

P.S.—Since the above pages were written, I have visited Dunbar, my native place, and I deemed it my duty to wait upon Captain Hunter, of Thurston, (whose father, the late James Hunter, Esq., had, as I have stated, taken so much interest in my invention,) to inform him of my intention of publishing my claim as the inventor of the screw propeller as the most suitable for ocean propulsion, when greatly to my astonishment and satisfaction, the Captain not only informed me that he had in his possession, but also showed me the identical propeller and machinery, which are represented by Fig. 6, page 25, with which I made the experiments in Leith Roads for the Highland Society in 1828. Captain Hunter spoke of having a boat built for them, to ply on a small lake near Thurston House, in honour of the invention and the interest his father took in it; but that anticipation was not carried out, as he died shortly after my visit to Thurston House. After his death the estate came into the hands of his nephew Richard Hunter, Esq., who seemed to have known but little of the taste and interest which his grandfather took in all such scientific subjects, and the propellers referred to above were cast aside as useless lumber, when an old friend, who knew something of their history, saw them amongst a lot of old scrap iron for the smith's use, and wrote to me about them, asking if I would like to have them as a memento of the past, and because I said I would like to see them again, they were sent at once, and are now in my office at my Foundry (September 1879), but I intend to send them to the Edinburgh Museum with a proper inscription prefixed on each of the four blades, being two right and two left hand portions of double-threaded screws, used in 1828 experiments, at Leith, page 25.

APPENDIX A.*

REMARKS on the introduction and progress of the Screw Propeller, with statistics of the comparative economy of Screw Ships and Paddle Vessels for Her Majesty's Service. Pamphlet published by Longman, Brown, Green and Longmans: London, 1856. See pages 55 to 62.

Statistics of the comparative Economy of Screw Ships and Paddle Vessels for Her Majesty's Service, with a Table of the relative speed of the several classes and descriptions of Ships. Compiled from the Navy List and other authentic sources, May, 1856.

TABLE No. 1.

A List of Steamers of all classes in Her Majesty's Service, fitted and fitting with the Screw Propeller.

Number of Ships.		Class of Ship.	Aggregate No. of Guns.		Horses' Power.	Total Horses' Power.
6		Troopers, mounting	36		2510	
6		Store Ships . . .			1910	
2		Water Tanks . . .			130	
2		Flour Mills . . .			200	
1		Floating Factory .			100	
1		Lighter			30	
1		Yacht			128	
						5008
162		Gun Boats, mounting	324		8680	
6		Floating Batteries „	84		1200	
						9880
72	140 Ships	Sloops, Corvettes, Despatch Gun Vessels, Mounting . . .	764	5492 Guns.	15602	†49312
25	140 Ships	Frigates	931	†	10760	
43	140 Ships	Line of Battle Ships	3797	†	22950	
Total 327ships		Total Guns	5936		Total H. P.	64200

* It may be only justice to state, that this Appendix is taken from a pamphlet evidently written to advance Mr. F. P. Smith's claim to a public reward; and certainly no better facts could be produced to show how much the nation is indebted to the Inventor of the Screw Propeller; but whether Mr. F. P. Smith is that individual, is a different question.

† 49,312 horses' power, divided by 5,492 guns, gives 8·9, or eight and nine-tenths horses' power to each gun on the average.

TABLE No. 2.

A List of War Steamers in H.M.'s Service, fitted with Paddle Wheels.

	Name.	Guns.	Tons.	Horses' power.
1	Barracouta,	6		300
2	Basilisk,	6	1000	400
3	Buzzard,	6		300
4	Cyclops,	6	1195	320
5	Devastation,	6	1058	400
6	Dragon,	6	1196	560
7	Driver,	6	1056	280
8	Firebrand,	6	1190	410
9	Furious,*	16	1255	400
10	Geyser,	6	1060	480
11	Gladiator,	6	1210	430
12	Hecla,	6	816	240
13	Hermes,	6	830	220
14	Hydra,	6	817	220
15	Inflexible,	6	1122	378
16	Leopard,*	18	1326	560
17	Magicienne,*	16	1255	400
18	Polyphemus,	5	800	200
19	Samson,	6	1299	467
20	Sidon,*	22	1328	560
21	Sphynx,	6	1058	500
22	Spiteful,	6	1060	280
23	Stromboli,	6	970	280
24	Styx,	6	1057	280
25	Terrible,*	21	1850	800
26	Retribution,*	28	1640	400
27	Valorous,*	16	1255	400
28	Virago,	6	1060	300
29	Vulture,	6	1190	470
	Total,	268		11,235

* A selection of seven of the largest and newest Paddle Vessels in the Navy.

	Name.	Guns.	Tons.	Horses' power.
1	Furious,	16	1255	400
2	Leopard,	18	1326	560
3	Magicienne,	16	1255	400
4	Sidon,	22	1328	560
5	Terrible,	21	1850	800
6	Valorous,	28	1640	400
7	Retribution,	16	1255	400
	Total,	137	9909	3520

9909 tons, total tonnage of seven vessels, divided by 7, gives 1415 as the tonnage of each vessel, and 3520 horses' power, divided by 137 guns, gives 25·7, or 25 and seven-tenths, as the average horses' power to each gun.

The same calculation upon the whole number of vessels is as follows:—11,235 horses' power, divided by 268 guns, gives 41·9, or 41 and nine-tenths, as the average horses' power to each gun.

A TABLE OF COMPARISON between the SPEED of SCREW and PADDLE sured Knot in Stokes Bay, and other officially measured distances; their propor-

SCREW SHIPS.

GUN BOATS.

	Guns.	Crew.	Tons.	Horse power.	Speed* in knots.	Average tons per gun.	Average men per gun.
130 of	4	36	238	60	8·8	59	9·0
12 ,,	4	30	232	40	7·5	58	7·5
20 ,,	2	25	212	20	6·9	106	12·5

DESPATCH GUN VESSELS.

Victor, Flying Fish	6	100	850	350	12·5	142	16·7
Mohawk, Wanderer	4	80	670	200	11·5	167	20·0

SLOOPS.

Rattler†	11	130	888	200	10·0	61	10
Archer	14	175	973	202	7·9		
Plumper	9	100	490	60	7·4		
Falcon, Harrier	17	100	750	100	10·2		

CORVETTES.

Pylades	21	240	1400	350	10·8	64	11·7
Cossack	20	240	1383	250	10·2		
Tartar	20	240	1322	250	10·3		
Esk	21	240	1153	250	10·5		

FRIGATES.

Euryalus	51	530	2371	400	11·0	41	10·3
Imperieuse	51	530	2357	360	10·5		
Dauntless	33	330	1569	580	10·3		
Hawke	60	600	1754	200	6·7		

TWO DECKED LINE OF BATTLE SHIPS.

Conqueror	101	930	3283	800	12·0	34	9·7
St. Jean D'Acre	101	930	3280	600	11·2		
Orion	91	850	3281	600	11·5		
Agamemnon	91	850	3281	600	11.3		
Cæsar	91	850	3100	400	10·2		
Brunswick, Colossus, Majestic, Cressy, Centurion	80	750	2589	400	10·5		

THREE DECKED LINE OF BATTLE SHIPS.

Marlborough	131	1100	4000	800	11·0	29	8·5
Duke of Wellington	131	1100	3759	800	11·0		
Royal Albert	121	1000	3726	500	10·0		
Royal George	102	920	2616	400	9·4		

NAVAL TRANSPORT SHIP.

	Guns.	Crew.	Tons.	Horse power.	Speed in knots.	Tons per horse.
Himalaya	—	—	3550	700	13·8	5

The Himalaya is constructed of iron, and had on board, at the trial of speed in Stokes Bay, 13th January, 1854, 700 tons of coal. Her screw is also of iron, weighs nearly 11 tons, and cost about £400. Gross power indicated at the time of trial, 2050 horses.

* Obtained from records of official trials kept by contracting engineers.

† Rattler was the first ship of war fitted with the screw in H.M. Service. Launched in 1843.

VESSELS, of similar classes in Her Majesty's Service, as ascertained at the measurement of tonnage to the number of guns carried, and the number of crew to each gun.

PADDLE VESSELS.

	Guns.	Crew.	Tons.	Horse power.	Speed* in knots.	Average tons per gun.	Average men per gun.
No vessels of this class.							

No vessels of this class.

	Guns.	Crew.	Tons.	Horse power.	Speed* in knots.	Average tons per gun.	Average men per gun.
SLOOPS.							
Polyphemus†	6	130	800	200	8·5	168	25·4
Prometheus							
Driver	6	160	1056	280	9·3		
Inflexible	6	160	1122	378	9·0		
Devastation	6	160	1058	400	10·0		
SMALL FRIGATES.							
Vulture	6	200	1190	470	10·0	113	19
Dragon	6	200	1296	560	10·0		
Magicienne	16	220	1256	400	10·0		
Valorous	16	220	1255	400	10·0		
FRIGATES.							
Terrible	21	300	1850	800	11·0	60	12·8
Retribution	28	300	1640	400	10·0		
Sidon	22	300	1328	560	10·0		
Leopard	18	235	1326	560	10·5		

No ships of this class.

No ships of this class.

NAVAL TRANSPORT SHIP.

	Guns.	Crew.	Tons.	Horse power.	Speed in knots.	Tons per horse.
Atrato	—	—	2721	900	13·9	3

The Atrato is constructed of iron, and had on board, at the trial of speed in Stokes Bay, 10th March, 1854, 290 tons of coal. Her paddle wheels (on the feathering principle) weigh 70 tons each, and cost about £5000. Gross power indicated at the time of trial, 3070 horses.

* *Vide* Weale's List of the British Steam Navy, published 1849, by permission of the Board of Admiralty.

† Polyphemus, Prometheus, and Alecto, sister ships to Rattler. Launched in 1839.

REMARKS.

THE strength of naval power being, in a very great degree, measurable by the number and weight of guns brought into action, the following calculations are given to show the *first cost* of hulls and *machinery* in proportion to the number of guns carried, without reference of any kind to the admitted advantages which screw ships possess over paddle vessels, viz., in being perfect sailing ships, independent of steam power, in presenting a *complete broadside* of guns to an enemy, and in having their machinery (of a much lighter description) placed entirely below the water line.

The speed of both descriptions of vessels under consideration is ascertained to have been at least equal.*

The estimate of power in the preceding tables is in nominal horses, because the first cost of machinery is always regulated by that standard.

For the purposes of a rough calculation of the current working expenses of screw and paddle ships, it may be as well to state that the indicated duty of screw engines over their nominal power is, in most cases, higher than that of paddle engines, and their consumption of fuel per *hour* is greater in a similar proportion; but as the screw ship performs all ordinary, and some special, services under sail, *without* steam, the consumption of fuel *per annum* of any given number of horses' power may be very fairly taken as equal, or in direct proportion to the nominal power of the engines employed. Every thousand horses' power consumes, on the average, about 100 tons of coals per day.†

Of the 327 screw vessels enumerated in Table No. 1, 140 of them consist of the classes denominated sloops, corvettes, frigates, and line-of-battle ships, which may be considered as the actual fighting force of screw ships in the British navy, independently of the 162 gunboats and six floating batteries. The collective force of the 140 vessels referred to is represented by an armament of 5492 guns, and a power of 49,312 horses, or about nine horses to each gun.

On the Paddle Table, No. 2, it will be found that the force of 29 vessels of all classes is represented by an armament of 268 guns, and 11,235 horses, or about 42 horses to each gun; the difference in favour of screw ships is therefore 33 horses, or a saving of £1980 per gun in the first cost of machinery alone.

It may not, however, be right to include the earliest of the 29 paddle vessels in such an estimate of their relative value. Seven of the largest and the newest of that number have therefore been selected to compare with the total list of screw ships, without reference to date or size; and taken thus, the paddle ships have about 25 horses to each gun—a difference of about 16 horses or £960 per gun in favour of screw ships.

Hence it would require three paddle steamers of 16 guns, 1255 tons, and 400 horses' power each, as "Valorous," "Leopard," and "Furious," to carry the armament of one 50 gun screw frigate like "Euryalus." The machinery of the "Euryalus," of 2371 tons, is 400 horses' power, the cost of which

* See table of comparative speed, in the preceding pages.

† The average price of coals consumed at home and abroad, in H.M. Navy, may be taken at about £2 per ton.

may be roughly estimated at £24,000, and her hull at £71,130, total £95,130; whilst the charge for machinery of the three paddle steamers would be £72,000, their hulls £115,080, together £187,080; showing a difference of £91,950, *first cost*, in favour of the screw frigate.

If any of the larger class of screw ships, as "Agamemnon," "Orion," etc., of 91 guns, 3,281 tons, and 600 horses each, or nearly seven horses to each gun, are taken as an example, and compared with the largest class of paddle ships, such as the "Terrible," of 21 guns, 1850 tons, and 800 horses' power, or 38 horses per gun, the difference is still more apparent; being 31 horses' power, or £1,860 per gun, in favour of the screw line-of-battle ships. In other words, it would require nine "Terribles" to bring into action an armament equal to that of "Agamemnon" and "Orion," the cost of which two ships would be—machinery, £72,000; hulls, £196,860; together, £268,860; whilst the cost would be for nine "Terribles"—machinery, £432,000; hulls, £499,500; together, £931,500; or a difference of £662,640 in favour of the two screw ships.

If such ships as the "Duke of Wellington," of 3,759 tons, and "Marlborough," of 4,000 tons, 131 guns, and 800 horses' power each, are taken as examples, the economy in the first outlay for machinery is proportionably increased beyond the case last stated.

The smallest class of screw fighting ships, such as "Falcon," "Harrier," and "Hornet," of 17 guns, 750 tons, 100 horses each, represent six horses to each gun, and the nearest approach to them on the Paddle List is "Devastation," "Basilisk," etc., of six guns, 1,000 tons, and 400 horses' power each, being 66 horses to each gun; the difference between these vessels being 60 horses, or £3,600 per gun original cost for machinery.

In all the preceding estimates the averages of each item have been taken; but if extreme comparisons are made, say between "St. Jean d'Acre" and "Falcon" (screws), and "Terrible" and "Dragon" (paddles), they stand as below.*

	£		£
* Falcon.—Total cost of hull and machinery *per gun*, .	1,635	Dragon.—Total cost of hull and machinery *per gun*, .	12,080
St. Jean d'Acre.—Total cost of hull and machinery *per gun*,	1,133	Terrible.—Total cost of hull and machinery *per gun*, .	5,000

It seems almost needless to carry this calculation further; but, as the full extent of it may not have been previously anticipated, one more view is given, as follows:—

It has been stated already that the actual fighting force of screw ships in the British navy, capable of being transported to any part of the globe, is 5,492 guns, and 49,312 horses' power, in 140 ships of various classes; giving a total average, say, of nine horses' power to each gun, or 16 horses less per gun than the best specimens of paddle ships, which average in tons 1,415 each; in horses' power, 503 each; and in guns, 20 each.

It follows, therefore, that 275 ships of this class would have been required to carry the 5,492 guns which are now carried in the 140 screw vessels, and that 138,325 horses' power would have been necessary instead of 49,312, showing a difference of 135 vessels and 89,017 horses; the cost of which would be £5,730,750 for hulls, and £5,341,020 for machinery, or a saving of upwards of eleven millions stering, without reckoning the cost of the maintenance of the crews, and other current expenses, of so many additional vessels.

To form some idea of the cost of pay and maintenance of the crews of such an extra number of ships, it is only necessary to glance at the table on pages 50 and 51, where it will be seen that the crews of paddle vessels average in the proportion of 19 to 10.5 men per gun more than in screw vessels of a similar denomination or class; and as this item of expense is

(so long as ships are in commission) constant, and unlike the steam engine, which only requires fuel occasionally, it would of necessity add to the national expenditure an annual sum quite equal to the cost of coals and other stores for engine room consumption.

These observations are not intended to imply that guns of the same size on board paddle steamers require more men to work them than they do in screw steamers, but that the difference arises from the fact that the former vessels average, in point of tonnage, 117 to 56 tons, or about 105 per cent. more in tons *per gun* than the three classes of screw vessels which have been selected for this comparison. The same table exhibits great economy in favour of the largest class of paddle ships, as well as screw ships, in point of tonnage per gun, men per gun, and tons per horse power; but as it may be urged that, if paddle ships were to be constructed as large as line-of-battle ships, there would be no difference in these respects, and as the practical limit to the dimensions of paddle wheels seems to have been almost reached in the "Terrible" and "Atrato," their weight, including paddle boxes and supports, being little short of 100 tons on each side, this circumstance, apart from their obstruction to the broadside, and consequent exposure of machinery, is in itself a sufficient reason for not enlarging on the proportions of the paddle ships of the navy.

By substituting the words "*tons* per horse," for "horses' power per *gun*," it will be seen that a similar saving is effected by the use of screw ships in the merchant and naval transport service; and this cannot be more clearly shown than by the fact that there are already about 400 merchant screw steamers in existence, and that but few paddle vessels are being built.

In conclusion, it may be remarked, that the present class of gun-boats could not have existed but for the introduction of the screw; as paddle vessels, sufficiently small for the purposes of gun-boats, could not carry heavy guns at the *bow* or *stern*, and to work them in the middle of the vessel, as is now done, would have been altogether impracticable, on account of the paddle-boxes.

APPENDIX B.

DOUBLE ACTION SCREW PROPELLERS.

In the propulsion of vessels by means of the screw propeller one great difficulty to be overcome is, the loss of speed arising from what is usually called the "slip of the screw," in the absence of a more explicit term or expression to explain the cause of this loss of speed, the actual cause being due to the yielding of the water behind to the reaction of the screw in forcing of the vessel forward through the water, action and reaction being in all cases equal to each other; so that, whatever the yielding of the water to the reaction of the screw propeller may be, the loss of speed in the vessel's forward motion (and consequently the loss of power in the same ratio) will be exactly equal in amount to the yielding of the water. This loss frequently amounts to as much as one-half of the progress that would be due to the pitch and number of revolutions of the screw in a given time, even if the propeller is constructed on the true principle of the helix, or perfect screw. In the endeavour to reduce this so-called slip to the smallest possible amount, the author made a large number of experiments, and found that the best results were obtained by making use of two propellers instead of a single one, and so arranging them that their combined action would produce an effect upon the water similar to that produced by the tail of a fish, or an oar in sculling; that is to say, the water being put in motion in one direction by the oblique action of the angled blades of the first or fore propeller, similar to the action of a fish's tail or a sculling oar, that motion of the water will in like manner be counteracted by an opposite action, obtained from the second or aft propeller, placed directly behind the first, and revolving in the opposite direction, having also its blades angled in the contrary direction to those of the first propeller, so that a more perfect resistance shall be obtained to meet the reaction of the screw propellers in forcing the vessel forwards, than would be the case were the motion of the water from the action of the first propeller allowed to continue without obstruction in the same direction, similar to the revolving motion which is given to the water when only one propeller is used.

The two propellers may each have two, three, four, or more blades, as the case may require, and although they may be of the same form in general use, with rounded back and expanding pitch, or otherwise, the author would prefer that they should be made as near as possible to the form of a portion of the thread of a true screw, whether of two, three, or more threads, according to the number of blades employed. When made of this form, the forward tendency of each portion of the blades, when in motion, will be exactly the same throughout.

The pitch or speed of one propeller may, however, be more or less than

that of the other, according to circumstances and requirements, and in order to prevent *vibration* the section of the blades should be such as will produce a direct line of screw action, and at the same time offer the smallest possible resistance in passing through the water, as is consistent with the strength required for the blades, &c.

This principle and arrangement of propellers may be applied to twin screws, on each side of the dead wood, or on each side of the rudder, or behind the rudder, or in the opening of the dead wood, in the same manner as most of the ordinary screw propellers now in use; but in place of the opening in the dead wood being, as usually made, so short fore and aft as merely to allow a clear space for the propeller to pass through, the author prefers it to be as wide as circumstances will permit, so that the water may have free access to the fore propeller and equally free exit from the aft one. The main and false stern posts, also, should both be bevelled inwards to the opening, so that the water may enter and leave freely, and with the least possible resistance, as shown in fig. 1, page 57.

THE FISH TORPEDO.

This invention is particularly adaptable for the propulsion of the Whitehead Fish-Torpedoes (shown in figs. 3 and 4), to which the double-action propellers have been applied with extraordinary success—the results being that a rate of speed equal to 27 knots, or 31 miles, per hour has already been obtained; and in consideration of so great an advantage as the attainment of this speed by so small a vessel as the fish-torpedo, the Secretary of State for War, on the 29th of March, 1880, sanctioned a payment of £500 to be made to the author for the application of his patent propellers to the fish-torpedoes made for H.M. War Department in the Royal factories.

Fig. 3 represents a side view or plan of the Whitehead Torpedo, to a scale of half an inch to the foot. In cross section it is round, the shape longitudinally being somewhat similar to that of a cigar, the ends being tapered almost to a point, and having the propellers *a*, *b*, at the very extremity, behind the rudders *d*, *d*, of which there are four, placed at right angles to each other. Two of these rudders are for guiding the torpedo to maintain a straight course, or a course to the right or left, as required, and the other two are for regulating the depth of the course below the surface of the water.

Fig. 4 represents a part section of the after portion of the torpedo, enlarged to a scale of one inch to the foot, showing the driving gear by which the right and left hand motion of the propellers on the same centre line of action is obtained.

Fig. 5 is an enlarged view of the driving gear. The same letters refer to identical parts in each of the figures: A or a, the aft and right hand revolving propeller; B or b, the fore and left hand revolving propeller; c, the main stern post, through which the tube *f* and shaft *e* protrude, and on which the propellers A and B are severally fixed, as in fig. 1.

Fig. 2. Stern view.

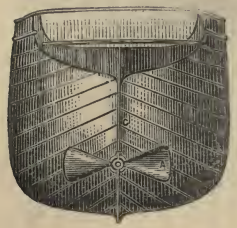


Fig. 1. Side view.

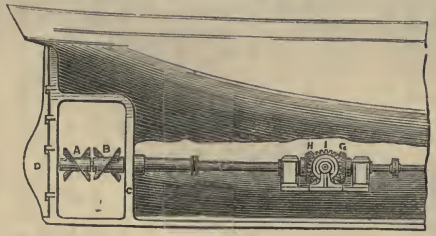


Fig. 5.
Plan of Driving gear for the Fish Torpedoes and Steam Yachts.

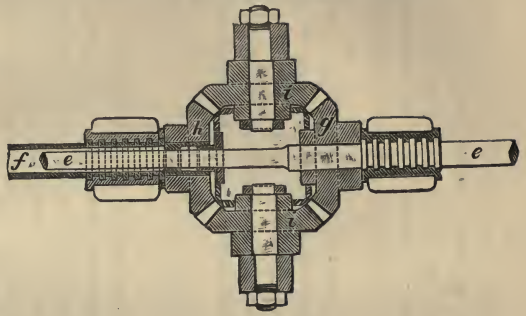


Fig. 4. Section of Torpedo. 1-Inch scale.

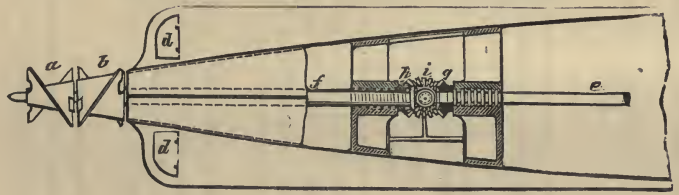
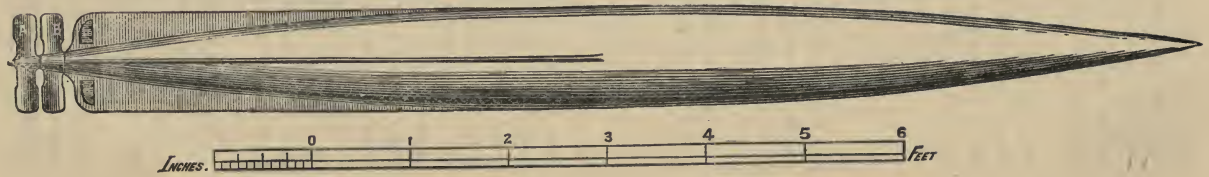


Fig. 3. Fish Torpedo, side view of. ½-Inch scale.



In figs. 1, 3, and 4, *e* is the main driving shaft, on which the right hand propeller A or a is fixed; *f* is the tube on which the left hand propeller B or b is fixed; *g* is the main driving wheel, fixed on the main driving shaft *e*, which gives motion to the two wheels *i*, *i*, which drive the wheel *h*, fixed on the tube *f*, on which is also fixed the left hand propeller B, as before stated.

Previous to the application of the author's double-action propellers to the Fish Torpedo, the maximum speed attained by a certain torpedo with the single propeller was 10¼ knots per hour, but after the application of the double-action propellers to the same torpedo a speed of 12⅓ knots per hour was attained, with precisely the same amount of power as before.

ROYAL LABORATORY, WOOLWICH, S.E.,
23rd June, 1877.

DEAR SIR,

In reply to your letter of 19th instant, I beg to inform you that in November, 1874, your double screw was put on a torpedo, which, with the single screw in use before that date, had given a speed of 10·24 knots for 200 yards at 36 atmospheres; the result was that a speed of 12·33 knots was obtained for same distance at same pressure. The average speed of torpedoes of this class since made in this department has been 12·5 knots. And believe me,

Yours faithfully,
(Signed) G. FRASER, *Col.*

R. WILSON, Sen., Esq.

To attain this increase of speed with the single propeller 73 per cent. additional power would have to be applied, assuming that it would have been possible to apply such additional power without churning the water that is causing it to revolve with the propeller, or otherwise causing the torpedo itself to revolve in the water in the opposite direction to the propeller. In either of these cases, or in a combination of the two, the greater portion of the power would have been absorbed without giving much forward motion to the torpedo. The power required to produce a speed of 12 knots per hour was calculated to be about seven horse power; and the power required to produce any given speed varies as the cube of the speed, therefore 27 knots being 2¼ times 12 knots, and the cube of 2¼ times 11.39, then $11.39 \times 7 = 79.73$, or nearly 80 horse power would be required to produce a speed of 27 knots per hour.

The attainment of this wonderful speed of 27 knots per hour by such a small vessel as the Fish Torpedo, with propellers revolving in a circle of 14 inches diameter, must be attributed to certain advantageous points, which may be said to belong strictly to the principle of the double-action screw propellers alone.

The first of these to be noticed as a primary cause of this unexampled speed being attained is, that the effect upon the water due to the action of the first or fore propeller being counteracted by the action of the second or

aft propeller prevents not only the circular motion of the water which takes place by the action of the single propeller, but also prevents the tendency which the torpedo itself has to revolve in the opposite direction to the propeller, when extra power is employed with a view of obtaining a high rate of speed. These two defects, if not counteracted by some sufficient means, would absorb almost the whole of the power expended, with little or no resulting forward motion of the torpedo.

The next point to be noticed is that, the above-named defects being overcome, almost any practicable amount of power may be applied in order to obtain the speed required. The same amount of power could not be applied with the single propeller without churning the water when extra resistance had to be overcome. This was clearly proved by an actual trial of the towing power of two boats. The two boats were each fitted with engines having the same power, with equal steam pressure, one boat being provided with a single propeller only, while the other was fitted with the double propellers, the trial was made by making fast the boats stern to stern, by a rope, leaving a space of about 30 feet between them. The boat with the single propeller used steam at a pressure of 120 lbs. per square inch, while the other boat with the double propellers, using steam of only 50 lbs. pressure per square inch, towed the first boat along behind her, as though there was but little extra resistance to be overcome. This experiment was repeated several times with the same result; the explanation of this, is simply that the whole of the power expended upon the single propeller, was absorbed in merely churning the water, while with the double propellers less than half the amount was expended, but that power was utilized for propelling only, there being no churning of the water with the double propellers.

Another point of advantage to be noticed is, that by having all the angular action and effect, of the one propeller counterbalanced by the opposite action and effect of the other propeller, the acting power of the rudder seldom requires to be brought into use, to maintain the vessel on a straight course, and thus a considerable saving of power is effected. Vessels fitted with the ordinary single propellers, require almost constantly, either a starboard, or a port-helm, according to their propellers being right or left hand screws, to maintain them on a straight course. This is especially the case when the vessel is pitching, when the screw being more or less lifted out of the water, racing ensues, which affects the vessel's course, and requires to be checked by the action of the rudder, which at the same time reduces the speed of the vessel. This is entirely obviated by the use of the double acting propellers, as the action of one is counterbalanced by the action of the other in any position. And yet another point of advantage remains, in as much, that a considerable greater speed can be obtained going astern with the double propellers, than with the single propeller. This advantage, coupled with the superior towing power, which was found to be about 50 per cent. above the single propeller in the experiments made with a Dynamometer; and the facility for stopping, and starting, which these extra powers confer, will be at once recognised as affording increased safety from risk of accidents and collisions which too frequently are the occasion of most lamentable losses of life and valuable property.

OPINIONS OF THE PRESS.

THE SCREW PROPELLER.

(*From "The Leader and Saturday Analyst (London)," June 2nd, 1860.*)

Out of a hundred persons on board a steamer at any time who are there for pleasure or for business, how many ever think of asking, Who invented the Screw Propeller? and even were they all to put the question, it is doubtful if the captain himself could satisfactorily answer it. About an invention so useful and so new, however, there should, we think, be no doubt whatever. Far back in antiquity we are not surprised to find that the origin of a thing fades into uncertainty or total obscurity, but we may reasonably be not a little astonished, that almost within the recollection of everybody now living a great and important invention is a subject of dispute and error. We know that the nation has been benefited by the invention, that our trade and commerce at home and abroad have increased by it, but who is the individual who has personally profited as the ingenious inventor of the Screw Propeller?

This question ought to be easily answered. The patentee is Mr. Smith, and he it appears, has reaped the honours and the rewards of the invention. But is he not *the* inventor? Mr. Robert Wilson says no, and his arguments in support of his own claim to the invention appear to be so strong and conclusive, that until we hear both sides of the question we can scarcely suspend our judgment. He says, "This invention, as the most suitable for propelling ships of war and other ocean steamers, I now for the first time publicly claim as my *own*, and I am confident I shall be able to establish, by *undoubted documentary evidence*, that I not only invented, and tested in the the sea before Committees of the Highland Society and Society of Arts, but at great personal sacrifices used all the means in my power to introduce the screw propeller for ocean navigation, long before Mr. Smith, the patentee, had even his attention directed to the subject; and that the screw might have been adopted in the navy as early as 1827, to the saving of millions of the public money."

We cannot follow Mr. Wilson through the process of evidence and testimony by which he establishes his claim to the invention, but must content ourselves with simply referring the reader, or any one interested in the matter—and who is not uninterested in seeing justice done to those to whom it is due?—to the little work upon the subject of his claim. We may, however, mention the singular fact, that the French represent M. Sauvage, of Havre, as the inventor of the screw propeller. M. Sauvage derived no pecuniary advantage from the adoption of the invention in France; and he, within the last few years, became so poor that the Emperor, having been informed of his position, undertook to provide for him. However, amid all rival and conflicting claims to the honour of the invention, we think Mr. Robert Wilson puts forth the strongest.

THE DISCOVERER OF THE SCREW PROPELLER.

(*From "The Haddingtonshire Courier," June 8th, 1860.*)

Mr. Robert Wilson, of the firm of Messrs. J. Nasmyth & Co., Manchester, now comes publicly forward to claim the merit of having first discovered

the screw propeller, though Mr. Smith has until now received the credit and the rewards. In the pamphlet which he has just published, Mr. Wilson brings forward very conclusive evidence that in 1827, at a period long anterior to the date of Mr. Smith's patent, he had discovered the principle of the screw propeller, and had actually verified it by successful experiments in Leith Roads in the presence of numerous noblemen and gentlemen, and members of the Royal Scottish Society of Arts.

The publication of this modest narrative unequivocally proves the claim of Mr. Wilson to priority of invention, and entitles him to the thanks of his countrymen, as adding another to the list of those illustrious Scotchmen who have by their native talent augmented the mechanical resources of the age.

THE SCREW PROPELLER; WHO INVENTED IT?

WITH ILLUSTRATIONS. BY ROBERT WILSON. T. MURRAY AND SON, GLASGOW.

(*From "The Scotsman," June 9th*, 1860.)

Questions as to the priority of inventions or discoveries are perhaps the most disagreeable that arise in the scientific world. Discoveries are frequently so much a result of the advance of knowledge, or of some felt practical necessity of the time, that we may almost say it is often a mere accident that determines who the individual discoverer shall be. Many minds are working on the same idea, or the necessity of remedying some practical defect has been felt by more than one individual, and the very conditions of the case lead to coincidence in discovery or invention. One, of course, by greater diligence, or what is called good fortune or *luck*, gets before his compeers in the race, and is the first to publish the results of his labours, and, by the established law of the scientific world, he who first makes known any new fact or invention is entitled to claim it as his own.

Simple as the rule seems, its application is often difficult. Some ingenious inventor publishes an important discovery, but wants the influence or energy to secure its full recognition by the public, and is overlooked or forgotten. In a few years some other person with more fortune or perseverance again brings it forward, and obtains the honour that of right should have fallen to his predecessor. In such cases reclamations are sure to follow, and questions of much nicety are sure to arise. These become more troublesome when an invention brings not only fame but profit, as in the case of the screw propeller, noticed in this pamphlet. The invention was patented in 1836 by Mr. Smith, a farmer at Hendon, supported by some monied men in London. In a pamphlet published in 1858, which we noticed at the time, the invention was claimed for a mechanic in Irvine, whose discovery was alleged to have been appropriated by an engineer to whom it had been intrusted. In the present pamphlet Mr. Wilson shows that in 1828 he brought a model of a similar propeller under the notice of the Highland Society, and that a committee of the Society, after seeing it work in the Union Canal, reported in its favour. In 1832 the Society of Arts for Scotland awarded Mr. Wilson a prize medal for the same invention, after testing it in a boat in Leith Roads, and strongly recommended that it should be brought under the consideration of the Lords of the Admiralty for trial on a large scale. Through the influence of Sir John Sinclair, Mr. James Simpson, advocate, and other friends, it was in 1833 submitted to the Admiralty, who referred it to the officers at Woolwich, by whom the papers were returned, with "the opinion that the plan proposed is objectionable." Mr. Wilson with some justice complains that no trial was made even of the model sent. In consequence of this unfavourable reception by the Admiralty, Mr. Wilson had no opportunity of bringing

his invention again under public notice till he found it patented by Mr. Smith in 1836, and in 1845 finally adopted by the navy, it would appear, on the recommendation of some of the very persons who had condemned it without trial when proposed by Mr. Wilson. It must be confessed that with such facts apparently established by official documents, Mr. Wilson seems to have been very hardly treated, and that a good case is made out, at least for further inquiry.

(*From "The Glasgow Citizen," 9th June*, 1860.)

Everybody is aware of the controversy which has raged, from time to time, as to who invented steam-boats. Was it Fulton on the Hudson, or Bell on the Clyde? or was it Miller, or Taylor, or Symington in their prior and more obscure experiments on Dalswinton Loch? A dispute of a very similar nature has arisen with respect to the inventor of the screw propeller. Hitherto, not only the renown of that invention, but the national reward, together, we believe, with a considerable yearly pension, has been enjoyed by Mr. Francis Pettit Smith, originally a farmer at Hendon in England. In 1858, however a pamphlet made its appearance, and was noticed in our columns at the time, claiming, on irrefragable documentary evidence, the invention of the screw propeller for three Irvine gentlemen—Messrs. Steedman, M'Cririck, and Maxwell Dick. The first idea of the screw was ascribed, in that *brochure*, to Mr. Steedman, and to his having noticed a resemblance between "the fish tail and scull." In the article "Irvine," however, in *Slater's Dictionary*, newly published, we find the following passage:—"Here was invented, by Mr. Wm. M'Cririck, the screw propeller; and, so early as 1824 or 1825, Messrs. William M'Cririck and Maxwell Dick constructed a variety of screws, and, during 1827 and 1828, made an extensive series of experiments with working models, to determine the best length and angle of screw. In these trials they applied varied arrangements of screw *to each side of the vessel*. In this way they discovered the most powerful description, as a strong person would do in pulling an oar against a weaker one. This object being gained, the next plan was to fix the approved screw in the best dynomical position, namely, in the stern of the boat, which they, in their experiments, had also proved." All this would, of course, detract nothing from Mr. Smith's claims if these Irvine mechanics had merely pursued their labours in privacy. But repeated attempts were made to push the invention forward. In 1829 it was brought before the Royal Society of Edinburgh, and in 1830 Mr. Dick introduced it personally to the Royal Society of London. Mr. Dick was assisted in placing his model and propeller before the latter learned body by Mr. Andrew Smith, Engineer, Princess Street, Leicester Square, who afterwards—namely, in March, 1831—was instrumental in getting the models back, and returning them to Irvine, where they are still preserved. Now, the supposition seems to be that Mr. F. P. Smith had got hold of the idea of the screw propeller from Mr. A. Smith, with whom he was in some way connected. At all events, there stands the broad facts that a screw-propeller emanated from the Scotch town of Irvine as early as 1829—that it was exhibited in London in 1830—and that it was not until 1835 that Mr. F. P. Smith had his attention turned at all to the subject, nor until 31st May, 1836, that the patent for his "improved" screw propeller was obtained!

But within the last week or two even the Irvine claimants have met with a formidable competitor. Mr. Robert Wilson, of the firm of Messrs. James Nasmyth & Co., Bridgewater Foundry, Patricroft, near Manchester, declares himself to be the original inventor of the screw propeller, the idea of which occurred to him as early as 1808. This gentlemen likewise brings

the honour of the invention to the country of Watt and Bell, being a native of Dunbar, on the east coast of Scotland. It is but fair, however, to state that both seem to have been prosecuting their experiments quite unknown to each other. In a pamphlet which Mr. Wilson has just published, and which is now before us, he gives an interesting account of the manner in which the screw suggested itself to his mind—from sculling, from the action of a fish's tail, and from combining the principle of a windmill with the reverse motion of an undershot wheel. From turning the matter over in his thoughts, he proceeded to make numerous experiments, continuing these, at intervals, during a period of nineteen years. All this we have only on his own authority, but in 1827—two years before the earliest date at which the Irvine experiments were made public—he had his stern paddles, or revolving sculls, brought under the notice of the Earl of Lauderdale, who promised to use his influence with the Lords of the Admiralty in order to have the principle tested on a large scale. Their Lordships, it turned out, were not to be moved; but from that time Mr. Wilson made no secret of his invention. A record of it is contained in the minute-book of the Dunbar Mechanics' Institution, dated 18th October, 1827. The model was likewise noticed and briefly described in the *Edinburgh Mercury* of 29th December, 1827. In 1828 it was brought formally under the notice of the Highland Society of Scotland. A sub-committee of that body witnessed experiments with it in Leith Roads, and gave in a somewhat lengthy report in its favour, in which they authorized the purchase of the model, and awarded £10 to the ingenious inventor. Here, too, we get a passing glimpse of another screw inventor, in the person of Mr. Waddell, of Leith Links, but his "blades being mere flat surfaces, set at an angle," had no chance, it seems, against Mr. Wilson's. In 1832 Mr. Wilson submitted his invention to the Edinburgh Society of Arts, and was rewarded with the Society's Silver Medal, value five sovereigns. The Committee appointed to report on the subject likewise strongly recommended the invention to the attention of the Admiralty for war-ships, the propelling power being "altogether under water," and out of the reach of shot. This was followed up by actual and influential appeals to Government, but without any favourable result—the officers of Woolwich Yard, to whom the matter was referred, having examined the papers respecting Mr. Wilson's invention, and pronounced the plan objectionable, on the ground that it involved "a greater loss of power than the common mode of applying the wheels to the side." These statements are all authenticated by a variety of documents and correspondence.

We have no wish to detract from the real merits of Mr. Smith. In reference to the screw propeller he occupies a similar position to that occupied by Fulton in the matter of steam navigation. His mode of exciting attention appears to have been, not to seek the patronage of learned societies, or to batter at the door of the Admiralty, but with the aid of friends to secure a patent, get up a screw vessel, and begin plying. On the Paddington Canal, and on the Thames, he showed the principle in actual and successful operation; while about the same time the accomplished Captain Ericsson was introducing *his* screw, and in a manner equally triumphant, in America. These two are, indeed, the Fulton and the Bell of steam-screw propulsion. They were the first to bring it into practical use. But the original thinkers and experimenters—the Millers, the Taylors, and the Symingtons of the invention—were clearly Mr. Robert Wilson, of Dunbar, and Messrs. Steedman, M'Cririck, and Maxwell Dick, of Irvine, who, after much early effort, struggle, and expense, have had the mortification of seeing the honours and emoluments passing into other hands.

THE SCREW PROPELLER; WHO INVENTED IT?

WITH ILLUSTRATION. BY ROBERT WILSON, BRIDGEWATER FOUNDRY, PATRICROFT.

(*From "The Manchester Daily Examiner and Times," June 20th*, 1860.)

It is not very long since the relative merits of Symington, Taylor, Miller, and Fulton, in the invention of the steamboat were fairly elucidated. The controversy was long and keen, but it served the interests of historical truth, and did justice to men who were benefactors of their race, and who, dying unrewarded for their share in introducing to the world a new agent in locomotion, left their names to the calm and impartial judgment of posterity. The latest development in steam navigation is the screw propeller, and the history of this invention has yet to be written. The pamphlet before us (pp. 54) is a contribution to that history. The author, Mr. Robert Wilson, is connected with the firm of Messrs. Nasmyth & Co., of the Bridgewater Foundry, at Patricroft, and during a long life engaged in mechanical pursuits. The books of reference in art and science tell us that the screw propeller as a means of locomotion at sea was perfected between 1835-9 by Mr. Francis Pettit Smith, who patented his invention, succeeded in getting it practically tested by the Admiralty, and ultimately adopted by the Government for the propulsion of our steam navy. Neither this formula nor Mr. Smith's merits as an inventor does Mr. Wilson seek to challenge. He simply desires to lay claim to priority of discovery of the *theory* of the screw as a means of propulsion. As early as 1808, Mr. Wilson had his thoughts directed to the subject. The first real step in advance he made by closely watching the motions of a self-acting windmill, the idea suddenly occurring to him that he could modify the sculling oar so as to make it serve as a means of propelling a vessel. This was simply by putting it in the form of a wind-wheel, capable of performing all the functions necessary for perfect action under water. Revolving sculls applicable to ocean propulsion, were the object of his search. Between 1819-21 he perfected his model (a fac-simile of which he gives) and made a number of experiments, his model boat being 2 feet 6 inches long and 6 inches broad. Between 1825 and 1827 Mr. Wilson still further improved his models. In his first experiments the propeller was placed in front of the rudder, but the most favourable results were obtained with it behind the rudder.

The invention is thus brought down to 1827. In that year the Earl of Lauderdale, through his son, then Captain of the *Glasgow* frigate, had the invention put before the Admiralty. Next year the invention came under the notice of the Highland Society, a sub-committee of which body fully reported on its merits, gave Mr. Wilson a sum of money to enable him to get propellers made on a large scale, to be applied to a boat which should be tried in Leith Roads. A boat 25 ft. long was obtained, the propellers applied, and the experiment took place in April, 1828, several naval gentlemen being present, including Vice-Admiral Sir David Milne. The minutes of the Highland Society, quoted in the pamphlet, fully prove the importance attached to the experiment at the time, and the satisfaction its results gave to the naval gentlemen who witnessed it. Four years after, that is in 1832, several of Mr. Wilson's friends desired him to bring his propeller before the Edinburgh Society of Arts. The minutes of the Society (2nd May, 1832) have the description of the experiments with what were at the time called "stern paddles." The concluding part of the report is significant, the Committee recommending that the Society "should give a strong recommendation of the principle upon which Mr. Wilson's stern paddles are constructed, which may be the means of bringing this invention under the notice and consideration of the Lords of the Admiralty, who may in all pro-

bability be disposed to give it a trial on the large scale;" especially as the motive being placed under water and out of the reach of shot, would be a matter of the greatest importance to the navy. In 1833, accordingly urged on by the late Sir John Sinclair, the Society of Arts brought the matter fully before the notice of the Admiralty, who transmitted the papers to the officers of Woolwich Yard, Messrs. Oliver Lang and Abethell. These gentlemen reported (17th September, 1833) that they had examined the paper and models, and give as their opinion (to which the subsequent history of the screw propeller gives a direct contradiction) "that the plan proposed (independent of practical difficulties) is objectionable, as it involves a greater loss of power than the common mode of applying the wheels to the side." Routine sees practical difficulties in everything out of the ordinary well-beaten tract. The difference between Mr. Wilson and Mr. Smith as competing inventors may be just the difference between applying to an unwilling and a willing Admiralty Board. Certainly those who urged Mr. Wilson to make his application, after knowing its result, would have had little encouragement to give Mr. Smith to apply in the same direction. But Mr. Smith did apply, under happier auspices. Had Mr. Smith, like Mr. Wilson, been quietly remitted to the Woolwich Yard routine, the verdict might have been "there is nothing in it," and the hopes of the inventor, as well as the progress of steam navigation, indefinitely postponed. Since 1841, the royal naval authorities, who in 1833 backed the side paddles, have adopted the screw in most of their ships, and Mr. Smith stands before the world as the originator of an idea which has more than anything else contributed to the extraordinary development of our steam marine within the last twenty years. We can make allowance for the feeling under which Mr. Wilson contrasts his own bad with Mr. Smith's good luck. The latter, however, would have shared the same fate had his invention like that of the former, been sent to a couple of Government underlings, evidently utterly incapable of giving an opinion upon it. But Mr. Wilson does not stand alone as a victim of Government discouragement. Captain Ericcson, it seems, was even with Mr. Smith in point of time in the invention of a screw, with which he towed a vessel at the rate of 10 miles an hour. The Captain offered his invention in 1837 to the Admiralty; but it was rejected. He went with it to America; introduced it into the United States navy, and the Ericcson propeller is to this day the type of motor generally followed in the American navy. The friends of Mr. Smith, knowing the thorough appreciation of his substantial merits as an inventor in this department, will hardly seek to ignore the claims of others to whose minds the theory of the screw had plainly suggested itself. An additional incentive to put the history of this matter fully before the public was supplied to Mr. Wilson, by the publication of an Admiralty minute issued in 1850, which contained, among other documents, a report of date May 2, 1840, embodying a statement to the effect that this report (on the Archimedes screw and Mr. Smith's patent) "was the first official one made to the Board on the subject of screw propulsion." While Messrs. Lang and Abethell's report of 1833 is on the Admiralty books, these words are contradicted. For those who wish to know more about the matter, we must refer to Mr. Wilson's pages. They prove beyond doubt that the career of the poor inventor is a very difficult and disheartening one; and that the legislature did wisely in removing the great obstacles which the old patent laws presented to meritorious men receiving the reward to which they were entitled.

THE INVENTION OF THE SCREW PROPELLER.

(*From "The Haddingtonshire Courier," June 22nd,* 1860.)

In reference to the claim made by Mr. Wilson, of Manchester, to the invention of the steam screw propeller—an extract from whose pamphlet on the subject we published the other week — a correspondent from Grangemouth, who knew Mr. Wilson intimately in his earlier years, writes :—

"In the summer of 1827 I visited my native town (Dunbar). The few days I then remained was with a relative who took great delight in young Mr. Wilson's inventive faculties. The model of the ocean steam-ship was then finished, with which we had several very satisfactary experimental trials, both with the side paddles and the stern revolving blades, or sculls, as they were then designated. I was at the time in charge of different departments on the Forth and Clyde Canal, and so thoroughly convinced was I that Mr. Wilson's invention would supersede the use of horses for tracking vessels on the canal, that I requested and obtained leave from him to take the model home, where several experiments were made at Tophill, No. 16, and in the canal at Port-Dundas, in presence of the late Governor and Council of the Forth and Clyde Canal. All the gentlemen present appeared well pleased with the invention, and passed high encomiums upon the inventor, and all signified their intention to take the matter seriously into consideration. A few weeks after the above experiments, I met the Governor, and again suggested the benefit to the Company likely to be derived by having the *Vulcan* passage boat—the first iron boat on record —fitted up with Mr. Wilson's apparatus. His reply, however, was to the effect that, after the failure of the paddle steamers on the canal, the committee were not convinced that the stern power would give greater facility or cause less injury to the canal banks. This, therefore, dispelled my hopes, and the model was returned to my friend with no satisfactory encouragement. It is not surprising, however, that Mr. Wilson's invention has taken root, and that within the past three years several of the Company's boats have been fitted up with the screw, which has been found to cause little or no surge on the canal, so much dreaded in former days. My motive for recalling the above circumstances, which came under my own observation upwards of 30 years ago, is simply with the view of bearing testimony to my friend's justly-merited title to the invention, of which he has been deprived."

WHO INVENTED THE SCREW PROPELLER?

THE SCREW PROPELLER: WHO INVENTED IT? BY ROBERT WILSON. GLASGOW: THOMAS MURRAY AND SON.

(*From "The Manchester Review," June 30th,* 1860.)

As a general rule inventors are an unfortunate race, nor is it difficult to find a reason for this unfortunate law of humanity. Men who are largely endowed with the shaping and contriving spirit of imagination seldom possess an equal share of those more solid qualities which are requisite to insure worldly success. A man of lively and creative imagination ought to have a larger share of common sense and business prudence than his neighbours, in order to prevent his becoming the dupe of his own ideas, which are sometimes merely mischievous delusions, until they have been carefully revised and amended by practical skill, so as to render them fit to perform the task which the inventor designed, but which he may have been utterly unable to succeed in making them accomplish.

A more common misfortune is the want of sufficient capital to enable the inventor to overcome the difficulties which he must encounter, in bringing his innovation upon use and wont into actual operation. This appears to have been the sole cause of Robert Wilson's failure to introduce the screw propeller into use, many years before Mr. Smith had ever thought of that invention. Taking for granted that the facts brought forward in his very interesting pamphlet are substantially correct, as we believe them to be, it is plain that Mr. Wilson was the real inventor of the screw propeller.

So far back as the year 1808, more than half a century ago, while residing in Dunbar, his native town, his attention was directed to the subject, but it was several years later before he tried to put any of his ideas into a practical shape. After a number of experiments he appears to have at last succeeded in making a model of a steam vessel with an apparatus for propelling it from the stern, a kind of revolving scull. The invention is thus described in the minute-book of the Dunbar Mechanics' Institution, October, 1827. "By it, the vessel goes with greater speed than with side paddles, and produces so little motion of the water as to fit it admirably for canal navigation."

Having been introduced to the Earl of Lauderdale, by Mr. Hunter, of Thurston, the President of the Dunbar Mechanics' Institution, Mr. Wilson was sanguine enough to fancy that he would now succeed in getting his invention patronised in high quarters. His lordship was supposed to have great influence with the Lords of the Admiralty, and he promised to use all his influence with them to have the principle tested on a large scale, in order that the merits of the invention might be taken advantage of for the public service. As might have been expected, however, the Lords of the Admiralty declined even to witness the experiments with Mr. Wilson's model, much less to give him encouragement to try its merits on a larger scale.

Nothing daunted by this neglect, Mr. Wilson had his invention brought under the notice of the Highland Society, by whom it was highly approved. The directors who witnessed the experiments declared that "the results of Mr. Wilson's ingenious application of the paddles or propellers at the stern of the boat" had answered their most sanguine expectations; and, to show their satisfaction, they not only sanctioned the purchase of the model, but also granted the sum of £10 to defray the expense of the experiments.

In 1832 the screw propeller was brought under the notice of the Society of Arts, Edinburgh, which granted the silver medal to Mr. Wilson, and reported most favourably of his invention, as having many advantages over the steam boats with side paddles. In 1833 another attempt was made to draw the attention of the Lords of the Admiralty to the invention, it being the opinion of some of the highest authorities that its application to ships of war, as well as merchant vessels, was a matter of very great importance. But Mr. Wilson was not able to make a favourable impression on the Board. Having examined the reports transmitted along with the model, the Lords of the Admiralty came to the conclusion that "the plan proposed (Mr. Wilson's screw propeller), independent of practical difficulties, is objectionable, as it involves a greater loss of power than the common mode of applying the wheels to the side." Discouraged by this rebuff, the noblemen and gentlemen who had till then been actively countenancing Mr. Wilson, gave up the matter in despair, "expressing great regret and disappointment that their influence and trouble had been spent in vain, and that the public service had been deprived of the use and benefit of a valuable invention." For his part he resolved to wait with patience, in the hope that some enterprising shipbuilder might be induced to take up the matter; but here his practical philosophy was put to a severe trial. "All my calculations

in regard to the screw," says Mr. Wilson, "were suddenly superseded on hearing, some time about 1836, that a Mr. Smith had not only made the same discovery as myself, but had actually taken out a patent for it. I thereupon gave up the matter in great disappointment, and under a feeling, which has become stronger with time, that I had not been fairly used by the Admiralty." In that opinion, any candid person who reads Mr. Wilson's pamphlet will be very much inclined to concur.

THE SCREW PROPELLER: WHO INVENTED IT?

BY MR. ROBERT WILSON. 8VO. PP. 54. WOOD ENGRAVINGS. GLASGOW: THOMAS MURRAY AND SON. 1860.

(*From "The Practical Mechanics' Journal," July 1st,* 1860.

The mystery which enshrouds the authorship of "Junius'" letters, and the discussions which have arisen therefrom, may fairly be said to be rivalled by the great controversy on the subject of "Who invented the Screw Propeller?" In the present case, Mr. Robert Wilson, so well known for his many inventions, particularly in connection with that splendid tool, the steam hammer, comes forward to assert his claims for consideration in the matter, and adduces, as we have long known he could do, some capital evidence in his favour. The little pamphlet which we are now discussing brings out many things which have hitherto been concealed from the public eye, or only dimly revealed. Mr. Wilson here gives, in chronological order, a history of the rise and progress of the screw propeller, first as it originated in his mind, and was subsequently put into practice. Pages 11-15.

The period to which Mr. Wilson here refers, when the experiments were made with a four blade screw propeller, is between 1812 and 1821. Following up the idea four years afterwards he made another model, and in order to obtain additional surface he applied four other blades, but the disadvantages were found so great that the number was soon reduced to the original four. Then after numerous experiments with blades at various angles or pitches, and of different breadths, a further reduction was made in the number of the blades. Three blades were tried, and then two, bringing the propeller as nearly as possible to the form used at the present day. The proper position was also duly thought of and tested.

This brings the time down to 1827; and in that year, through the kindness of the President of the Dunbar Mechanics' Institute, the author was introduced to the Earl of Lauderdale, who, in company with other influential gentlemen, witnessed experiments with the model, when the superiority of the screw, or revolving sculls, as they were then called, was most apparent. His Lordship undertook to bring the invention under the notice of the Lords of the Admiralty, and the heart of the young inventor beat high with expectation. But here we have the old, old tale: "my Lords" refused to notice the invention, or even witness the experiments with the model. This was a death-blow to the sanguine hopes which had been built on the sandy foundation of official justice and liberality. In 1828, the Highland Society, after a committee had witnessed the experiments, voted £10 to enable Mr. Wilson to apply it to a 25 feet boat. She was fitted with two screws arranged longitudinally, the motion of the driving handles being communicated to the screws by means of bevel gearing. On the day of trial the weather was very stormy. The boat, however, fully answered the expectations which had been formed, and gave the inventor full confidence in the principle as applicable to steam ships exposed to heavy storms at sea. The correctness of Mr. Wilson's views on this point is now familiar

to everyone, as the exposure of the British fleet during the recent gales amply prove. In May, 1832, the Royal Scottish Society of Arts appointed a committee to make experiments with a boat 18 feet long. These experiments gave great satisfaction; and the applicability of the propeller to ships of war was particularly dwelt upon, in consequence of its being under water and out of the reach of shot. Another effort was made with "my Lords," and after the usual tedious delay, a report from Mr. Oliver Lang, of whom one would have expected better things, and from Mr. R. Abethell, was issued, stating "that the plan (independent of practical difficulties) is objectionable, as it involves greater loss of power than the common mode of applying the wheels to the side." And here ends Mr. Wilson's sad experience of Admiralty management. In language remarkable for its temperate tone, and which reflects the highest credit on the author's good sense, he thus notices the introduction of Mr. Smith's screw (see pages 36 and 38).

It is somewhat remarkable that after "my Lords" did condescend to notice Mr. Smith's propeller, backed, as it was, by the weighty influence of a banker, that neither they nor their intelligent Barnacle Tites should remember that one Robert Wilson had, in 1827, and again in 1832, brought before them a similar invention, as their letter books would prove. But there was this difference in the propellers, that Robert Wilson's was far superior to Smith's, for it closely resembled the most approved form of screw of the present day; for the inventor had gone through a series of experiments exactly similar to those upon which "my Lords" subsequently expended so many thousands of the public money. The rejection of Mr. Wilson's invention by the Admiralty and the subsequent adopting it at other hands, is one of a hundred similar cases of injustice which might be adduced. And although it may be but poor consolation to him that others equally deserving have been rejected, it must nevertheless afford him some consolation to think that he is one of that noble company who are indeed the true benefactors of the human race.

ADMIRALTY SLUGGISHNESS AND INCOMPETENCE.

(*From "The Standard" (London), January 26th*, 1861.)

No. IV.

TO THE EDITOR.

Sir,—I am told if I succeed in rousing public attention to the defective administration of the navy I shall render a great national service; "that nothing sinks into the English mind like facts; that what is wanted is specific instances of incompetence and neglect—not mere rumours, but well authenticated facts. Scatter such broadcast amongst the community, and they will bear fruit." I fully subscribe to the soundness of this advice, and flatter myself my correspondent will find this letter not entirely barren of the species of facts he desiderates.

It is difficult to conceive anything more obvious with regard to the equipment of a ship of war than the vast superiority of the screw as a means of propulsion over the paddle-wheel. The great diminution in space for carrying guns crippling the vessel's broadside; the liability of the machinery to injury from the enemy's shot; the increased tendency to roll, caused by the great addition of weight to the extremity of an increased beam—are three evils most injurious to a vessel's efficiency for war purposes, inseparable from the cumbrous appendage of paddle-wheels, but all entirely obviated by the substitution of a snug submerged propeller at the stern. In short, plain common sense, unaided by technical or professional know-

ledge, cannot fail to recognise at a glance the great advantages the screw has over the paddle-wheel as a means of propulsion for ships of war. Let us now see how a residence in the foggy atmosphere of the Admiralty, muddles the intellect and weakens the vision, till at last total blindness to the most palpable facts ensues.

Mr. Robert Wilson to whom belongs the honour of having invented the first practically successful form of screw propeller for ocean navigation, after many years' consideration of the subject and various experiments, made in 1826 a model driven by clock-work, which showed very satisfactorily the advantages of the screw propeller over the ordinary paddle-wheel. The late James Hunter, Esq., president of the Dunbar Mechanics' Institution, regarding the invention as a valuable one, introduced Mr. Wilson to the Earl of Lauderdale, who requested his son, the Hon. Captain Maitland, commanding the Glasgow frigate, to accompany Mr. Wilson with the model to a sheet of water in the neighbourhood, and report the result of the experiment to his Lordship. Sir William Houston and several leading members of the institution accompanied the captain, and all present expressed themselves delighted with the result of the experiments.

"The following morning," says Mr. Wilson, "my attendance was requested at his lordship's residence, Dunbar House, when he expressed himself highly satisfied with the report, and promised to do all he could with the Admiralty to have the principle tested on a large scale, in order that the merits of the invention might be taken advantage of for the public service. His Lordship was convinced the invention was worthy of immediate attention and investigation, but at the same time expressed to his son a doubt as to whether all the influence he could bring to bear would be sufficient to move the Lords of the Admiralty to action in the matter. I was, however, sanguine enough to suppose that, as the earl had taken up the matter warmly, and seemed determined to leave no stone unturned on his part to bring the invention into notice, there was no fear of success; but, to my great astonishment and regret, the Lords of the Admiralty declined even to witness the experiments with my model, or to take any notice whatever of the invention." And here it will be instructive to pause in our narrative for a moment to contemplate the services that this invention thus unceremoniously dismissed by the Admiralty, without being even entertained, is at the present moment conferring on the country. The power of a navy is represented by the number and weight of the guns that compose it. Paddle-wheel steamers, compared with screw, require double the horse-power and double the tonnage for each gun carried. To carry the 10,000 guns mounted by the screw steamers of the British navy in paddle-wheel vessels would therefore require twice as many ships, with twice the engine power, and such a fleet would cost £20,000,000 more to construct, and more than twice as much annually to maintain, without possessing half the efficiency of our present navy.

Mr. Hunter, still confident of the value of the invention, notwithstanding the rebuff from the Admiralty, determined to make another effort to have its merits properly tested, and applied to the Highland Society, of which he was a member, to prevail on the council to order a trial on a large scale, and after appointing a committee to witness experiments with the model, and receiving a favourable report, the council consented, and, in April, 1828, Mr. Wilson fitted his invention to a boat twenty-five feet long in Leith. Vice-Admiral Sir David Milne, and other members of the Society, attended at Leith to witness the experiment, and the success obtained was of the most solid and practical kind. Captain Boswell, R.N., Captain Trotter, R.N., Mr. Macpherson Grant, Mr. Macdonald, the secretary, and Mr. Wilson, being propelled by two men round the Martello Tower at the rate of ten miles an hour in a rough sea, Captain Boswell stating that the

same boat with four oars, under the same circumstances, would have taken half-an-hour to accomplish the distance achieved with the propeller in 17½ minutes. "So rough," says Mr. Wilson, "was the sea on the day when the experiments were made, that none of the pilots could be induced to accompany the experimentors with either oars or sails in any of their boats, and fears were even expressed by the gentlemen on board that the boat could not stand the severe action of the waves and return in safety; but the continuous and rapid motion given by the propellers kept the boat not only free from rolling, but also under the most perfect control, which soon satisfied them as to her safety. She obeyed the helm most promptly in every position relative to the wind and waves, which gave me full confidence in the principle as applicable to steam ships exposed to heavy storms at sea."

In 1832, Mr. Hunter, still confident of the success and the importance of the invention of the screw-propeller, brought the subject before the Royal Scottish Society of Arts, who, recognizing its importance, had a boat fitted at Leith with the invention, and appointed a committee to experiment. The result was highly satisfactory, and Mr. Wilson was awarded the Society's Silver Medal, value five sovereigns, the committee reporting that Mr. Wilson's propeller "possessed in many respects manifest advantages over the common side paddles, and could be easily adapted, not only to merchant ships, canal boats, and steam boats generally, but also to ships of war. They can be kept altogether under water and out of the reach of shot, and answer equally well in rough as in smooth sea." In consequence of this report, Sir John Sinclair, Sir Thomas Dick Lauder, Vice-Admiral Sir Davin Milne, and other members of the Society, imbued with a "love of perfection," resolved that the report, together with the propeller and machinery with which the experiments were made, should be forwarded to the Lords of the Admiralty, with a strong recommendation that the propeller be tried with steam power, and on a larger scale, as an invention of great value to our mercantile marine, and pre-eminently adapted for ships of war.

This was done, and the report and machinery were referred by their Lordships to the officers of Woolwich Dockyard, who reported thereon as follows:—"The plan proposed (independent of practical difficulties) is objectionable, as it involves a greater loss of power than the common mode of applying the wheels at the side." Perhaps many will be of opinion that, under all the circumstances of the case, this decision was hastily arrived at; but such persons do not sufficiently consider that benighted individuals dwelling so far north as Edinburgh, would hardly be expected, even with the aid of carefully-conducted experiments, to attain to that insight into the question arrived at at a glance by officers of Her Majesty's Royal Dockyard of Woolwich, residing, if not actually at head-quarters, within easy distance of that focus of enlightenment—the establishment at Whitehall. Mr. Wilson, not sufficiently imbued with this view of the case, observes on this report of the dockyard officials as follows:—"They had referred to them the particulars of an invention that had actually been tested on the open sea, and had been declared by the committee appointed by the Scottish Society of Arts, on the strength of personal observation, 'to possess manifest advantages over the common side paddles, and which might be easily adapted to merchant ships and ships of war.' They had the very apparatus sent them, with which they could have put the invention to the test; and yet they did not try it, for an assigned reason which all subsequent experience has proved to be totally untenable, and thus deprived the Government of an opportunity of obaining a valuable invention gratuitously and of saving millions of the public money."

T. SYMES PRIDEAUX.

Willow House, Hampstead, *Jan.* 25.

THE SCREW PROPELLER—WHO INVENTED IT?

(*From "Eccles Advertiser and District Recorder," January 26th*, 1861.)

The great and rapid progress made by our country during the last eighty years, both as regards position, importance, and the accumulation of capital, is mainly due to the wonderful Mechanical inventions by which this period has been so highly distinguished, and the names of Watt, Arkwright, Hargreaves, and others, will be handed down to posterity as benefactors to the country, and of whom the nation may well feel proud. And amongst these inventions, few, if any, are of more importance to us as a Maritime Nation, than that of the Screw Propeller, which has already saved millions of the public money, and worked a complete revolution in ocean sailing, the inventor of which is deserving the thanks and lasting gratitude of the people, but as in the case of all great improvements when *once established*, a host of rival competitors are in the field, each claiming to himself the honour of the invention, but to whom the honour and credit of this splendid invention really and truly belong, can no longer, we think, for a moment be a matter of doubt or uncertainty, after reading a pamphlet lately published by our distinguished neighbour Robert Wilson, Esq., of the Bridgewater Foundry, Patricroft, entitled "The Screw Propeller, Who invented it," in which, we think, the author clearly and indisputably makes good his own claim to whatever honour and credit is attached to so great and important an invention. We have read this pamphlet with both interest and pleasure, and find it to be remarkable for an honest simple statement of facts, each of which, step by step, is substantiated by incontrovertible documentary evidence, which places (at least to our minds) the whole question beyond doubt or cavil. The facts are arranged in chronological order. Commencing so early as 1808, at which time the author states that he resided at his native place Dunbar, a seaport on the east coast of Scotland, and as his father was connected with the Mercantile Marine Service, he spent a good portion of his time in aquatic amusements. In that year, long before the introduction of paddles for sea-voyages, an ingenious private soldier, stationed with his regiment at Dunbar, fitted out a small fishing boat with a pair of side paddles, in order to show their superiority over ordinary pulling oars, which they effectually did in smooth water, but when tried in the open sea, and the water somewhat agitated, the result was not so satisfactory. The reason was simply this, that when the water was agitated, the floats of the paddle wheels were either too deep in the water, and therefore choked, or nearly out of it, and doing little more than skimming its surface, and this producing little or no effect, and incapable of making much headway against the wind and waves, the experimont clearly showed that side paddles were not suitable for the open sea, or where the surface of the water was much agitated. Mr. Wilson having witnessed these experiments, and having what people called "an inventive turn of mind," the idea occurred to him that if anything like the oar used in the process of sculling, could be fitted to the stern of boats and ships, and worked by machinery, such a contrivance would be free from the objections attached to side paddles, seeing the sculling oar not only went deep into the water, when in action, but fish-tail like went forward with the boat whilst in the act of propelling. But the question, however, was, *how* the sculling oar could be modified so as to be driven by a constant motion, like that applied to the paddle wheels. But being at that time, not only a mere boy, but totally unacquainted with even the rudiments of Mechanics, was therefore quite unable to solve the difficulty *how* this modification was to be accomplished. The idea, however, seems to have taken deep and permanent root in his youthful mind, for although, for the reasons given above,

no immediate results presented themselves, yet the notion seems never to have been lost sight of, for he informs us that in a few years after witnessing the soldier's experiments with the paddle wheels, he accidentally saw on the farm of Oxwellmains, in East Lothian, a wind-mill used for thrashing corn, but the event which gave the first idea of an invention which has ultimately assumed such vast proportions, is in itself so interesting that we must quote the author's own description: "The mill was not working, and I had therefore a better opportunity of studying it; I lay down on the grass field opposite the mill, so as to use my knee as a rest for a telescope, and in this position, while engaged in wonder and admiration, trying to follow and account for the various motions which I knew the mill to have, an idea suddenly occurred to me, which rendered it perfectly clear in what way I could modify the sculling oar, so as to make it serve as a means of propelling a vessel. This was by putting it in the form of a *wind wheel*, such as that I had before me, which I saw embodied the very principle I had been in search of—being capable of adaptation for performing all the functions necessary for perfect action under water. I therefore concluded that revolving sculls would be specially applicable to ocean propulsion, and I determined to make the demonstration of this opinion the object of my ambition. My energies, however, were cramped for a considerable time, owing to the want of means to carry out my ideas, but a small model in wood with a set of four blades or 'revolving sculls' was made, and found to act as perfectly under water as I had seen the wind-wheel do in the air."

From 1825 to 1827 he seems to have been gradually approaching nearer and nearer to the form of screw now universally adopted as yielding the best results in proportion to the power applied—and in this particular case is presented another of those remarkable instances in which original inventors often see, and are enabled to shadow forth (if not able to realise their own ideas) all the improvements which ultimately have been added to the original invention, for even at this early period in the history of the Screw Propeller, say 1827, we find that Mr. Wilson had already arrived at and constructed his propellers of the same form and proportions as that used in the Great Eastern Steam Ship in 1859, a result arrived at by others, after many tedious years' study and experiment. Up to this period, the experiments had evidently been made entirely by himself, and out of the limited means at his disposal; but in 1827 he was introduced to the late James Hunter, Esq., of Thurston, president of the Dunbar Mechanics' Institution, of which Mr. Wilson was a member. Mr. Hunter appears to have done all in his power to bring the invention into notice, and introduced Mr. Wilson to the Earl of Lauderdale, whose son the Hon. Captain Anthony Maitland, then Captain of the frigate "Glasgow," along with Sir William Houston and several leading members of the Dunbar Mechanics' Institution proceeded to witness upon a large sheet of water experiments made by the revolving sculls (as the invention was at that time called) as compared with the side paddles, and the result was such as to satisfy all who witnessed them of the vast superiority of the new invention when the water was somewhat agitated, and consequently more suitable for sea voyages. The Earl of Lauderdale expressed himself so highly satisfied with the experiments that he promised to use all his influence in order to bring the invention under the notice of the Admiralty, with a view of having it tested on a large scale, but the Lords of the Admiralty declined even to witness the experiments or to take any notice whatever of the project. In 1828 Mr. Wilson was enabled to bring his invention before the Highland Society of Scotland, who appointed a Committee to examine and report upon its merits. A report was drawn up, and presented to the Society highly favourable to the ingenious inventor, and recommending that *ten pounds* be awarded to him towards the cost of his models.

In 1832 the invention was brought before the "Society of Arts," now the "Royal Scottish Society of Arts," which Society also appointed a Committee consisting of Sir Thomas Dick Lauder, Bart., Vice-President; Mr. Hunter, of Thurston; Mr. Crawford, of Cartsburn; Vice-Admiral Sir David Milne, Captain Watson, R N., Mr. Whytock, Mr. Todd, Secretary, and Robert Stephenson, Esq., C.E. This Committee, after a variety of trials not only expressed its entire approval of the invention, but strongly recommended that exertions should be made to bring it before the Admiralty as being of the greatest importance to ships of war, the propelling power being out of the reach of shot. They also at the same time awarded to Mr. Wilson the Society's silver medal, value five guineas. In 1833, after great exertions on his own part, and the valuable assistance of many friends, he at last succeeded in getting his plans and a model of his splendid invention brought before the Lords of the Admiralty. And now he seemed to be in a fair way of realizing his most cherished hopes, but alas! instead of the discovery being hailed as it ought to have been, as one of the first importance and value to the public good, the Barnacles of the circumlocution office again not only refused to acknowledge the value of the invention, but as if to add insult to injury, presented a report condemning the principle of stern paddles, "as (independent of practical difficulties) objectionable, as involving a greater loss of power than the common mode of applying the wheels to the side." Thus was his long-cherished ambition and desire to be useful to his country, unjustly, cruelly, and with official coldness doomed to the most severe disappointment, and after 25 years more or less of labour, privation, and anxiety, he found himself little or no nearer the realization of his boyish hopes and his more matured anticipations, than when first experimenting with his small models or gazing with delight upon the windmill at Oxwellmains; and in 1836 all his calculations of uselulness in regard to the screw were suddenly blighted on being informed that a Mr. F. P. Smith had actually taken out a patent for the invention that he Mr. Wilson had brought out, and shown in operation to hundreds of people more than 20 years before—and the honour and profit carried away by another, whose only claim to either seems to have consisted in coolly appropriating to himself the ideas and inventions of an abler man than himself, and the faculty of enabling him to impose upon others the belief that they were his own.

But we venture to predict that whatever injustice the present generation may have inflicted upon Mr. Wilson in reference to the screw propeller, the next will ever associate his name with this splendid invention, and look upon him as one to whom the Nation owes a heavy and lasting debt of gratitude. We regret that our space will not allow us to make more copious extracts from this little pamphlet, every page of which possesses deep interest to those who care for such matters, and to all such we earnestly recommend a careful perusal of the book itself.

PROCEEDINGS OF THE SCOTTISH SHIPBUILDERS' ASSOCIATION, 1864-1865.

ZETLAND PLACE, GRANGEMOUTH, 1*st October*, 1864.

ARCHD. GILCHRIST, Esq.

DEAR SIR,

I was duly favoured with yours and the enclosed this morning, and sorry am I to state that there are now no copies of communications with my friend Mr. Robert Wilson in my possession. You are aware that I contracted with, in 1818, and built for, the Forth and Clyde

Canal Company the "Vulcan," iron passage-boat, considered the first iron vessel on record. There was no angle iron in those days, nor any machinery, except an old-fashioned piercing machine purchased from Mr. Robt. Baird, Old Basin, a cast-iron grooved block to form the ribs, a smith's fire, one foot kneed at a heat considered good work. I recollect visiting my native place, Dunbar, in the summer of 1827, and was so delighted with Mr. Wilson's model steamer, propelled by the stern and side wheels,* that I prevailed upon him, and he granted me the loan of it, on condition that if the Canal Company approved of it, I would suggest and advise them to employ Mr. Wilson to produce plans to convert the "Vulcan" into a stern-propeller steam-boat. Being aware that the chief objection to the first side-wheeled steamboat, built by Mr. Symington in 1801, was the impression that the side-paddles caused too much surge and injured the banks, on taking the model home, and having made the trial, I found the greatest speed was produced by the side-paddles when there was no surge, but when the water was not smooth the stern-propeller produced fully a little more speed, and caused very little swell. Being convinced that boats of this description were the most likely for canal traders, I took the model to Port-Dundas, where it was exhibited in presence of the late Kirkman Findlay, Esq., Governor, and a few other Directors, who appeared satisfied that it was a great improvement. One of them, however, seemed to hold by the old system—that no machinery could be made to supersede the horse-power for tracking vessels on the canal with greater safety and less expense. My suggestion was therefore deferred to another period, and I am sorry to say there is not one of those gentlemen now in life to witness the number of steam lighters trading on the canal on the principle then proposed.

The letter published in the Haddington paper to which Mr. Wilson refers, if I mistake not, was intended to corroborate a statement in a former paper in favour of Mr. Wilson being the first inventor of the screw-propeller.

I have given you a hurried statement, and if it prove worth your notice, and add anything to convince the English folks "that bodies on this side of the Tweed are rather a step in advance," I will be gratified.

I am, Dear Sir,

Yours most respectfully,

THOS. WILSON.

THE SCREW PROPELLER AND WHO INVENTED IT.

(*From "The North British Daily Mail," Glasgow, June 24th*, 1872.)

A recent article in our columns, on the origin of the screw propeller, has had the effect of bringing out another claimant for the honour of that invention, in the person of a countryman of our own, Mr. Robert Wilson, a native of Dunbar. From the evidence afforded, the proofs of Mr. Wilson's priority of claim are indisputable. He is the actual inventor of the screw propeller, and not any one else.

This gentleman when, in 1808 and afterwards, a working joiner and cabinetmaker in Dunbar, appears to have pursued a path of inventive experiment in relation to screw propulsion entirely his own, and for many years his operations were unknown to any but a narrow circle of intimate friends, and only to them when his plan had reached considerable maturity and com-

* The model was so fitted with side-wheels and stern-paddles, or screws, in order to show the difference of effect when one or the other was used, but not for both to be used at the same time.

pleteness. In our article we alluded to a Dr. Short, an English mechanician, as having in 1802 started the notion of propelling sailing vessels by something of the character of screw action, hand worked. This project never came to anything, and very probably never would have been heard of, from that time to this, but for the success of the plans Mr. Wilson and later inventors applied to steam navigation. Mr. Wilson in a pamphlet he has published, lets us into the secret of his earliest cogitations on this subject. In 1808 his attention was first directed to it from an attempt made by a Lanarkshire lad, a private soldier in a regiment then quartered in Dunbar, to propel a fishing boat by side paddles. It was found that this plan was suitable only for smooth water. Being an adept at sculling, he thought of the possibility of propelling ships and boats by a scull worked with machinery. It is the prerogative of genius to detect identities under the variety of appearance, and Mr. Wilson saw in a running stream and an undershot wheel impelled by it; in a wind mill, with the sails set obliquely to the direction of the wind, the suggestive elements of the screw propeller. He had but to consider the paddle-wheel of the soldier's boat, "as representing the undershot wheel, with its action reversed," and the "wind wheel, with its action reversed," as a sculling oar when he had, with the combination of these mechanisms, the screw propeller ideally before him.

This project of screw propulsion began, in his apprehension, to assume greatly increased importance. He rightly concluded (1821) that revolving sculls, which he called "rough sea or storm paddles," would be especially applicable to ocean propulsion, and he "determined to make the demonstration of this opinion the object of his ambition." He remarks, "my energies however, were cramped for a considerable time, owing to the want of the necessary means to carry out my ideas, but a small model in wood, with a set of four blades or revolving sculls was made, and found to act perfectly under water, as I had seen the wind wheel do in air." Subsequent to 1821, and between 1825 and 1827 a larger model was made, with various propellers, having severally two, three, and four blades, driven by clock work, and comparative trials were made of screw and side paddles. In smooth water the side paddles won the race, and in rough water the screw, and the latter very decidedly. In 1827, and after the attention of competent critics, of men eminent in naval and civil life, came to be drawn to Mr. Wilson's plans, they at length, more than once, emerged before the Lords of the Admiralty. The Earl of Lauderdale brought the invention before the Government, and they referred it to the Admiralty Board, who rejected it, thereby gibbeting most conspicuously their own ignorance and incompetence.

At this period, from 1825 to 1828, the public proofs of Mr. Wilson's prior claim to the invention of the screw propeller become clear and conclusive. This was more than nine years before the date of the patent (1836) of Mr., now Sir F. P. Smith, for reputedly the first screw propeller. In 1827 Mr. Wilson's plans were before the Government. They were then noticed in the Edinburgh papers, and brought before the Dunbar Mechanics' Institution, while under the presidency of Mr. Hunter of Thurston. Between 1828 and 1832 the attention of the Highland Society of Scotland was called to this method of propulsion, as suitable to canal navigation, to whom he gave up his experimental model, receiving in return £10 to assist this working lad, which Mr. Wilson then was to continue his experiments. A letter from the Secretary of the Society to Mr. Wilson speaks of the paddles or propellers at the stern of the boat as "answering their most sanguine expectations." In 1832-3 the Society of Arts, Edinburgh, had Mr. Wilson's invention brought before them, and their report of trials at sea upon the propulsion of a boat 18 feet long and 7 feet broad is expressive of "high gratification with the results of the experiments." The Society's silver

medal was granted to Mr. Wilson, with a letter from the Secretary to the effect that the "manifest advantages over the common side paddles of the screw propeller are such as to permit of its being easily adapted, not only to merchant ships, canal boats, and steamboats generally, but also to ships of war. The screw can be kept altogether under water, and out of the reach of shot, and it answers equally well in rough as in smooth sea." Again, in 1833 Mr. Wilson's invention was laid before the Admiralty, and again it was rejected. He was backed by the best influence in Scotland, but that was of no avail, the screw was rejected as being inferior to side paddles for steamship propulsion. They had never put the invention to a test, but "my Lords," trusting the opinion of underlings, allowed a report on this matter, under their name, to be issued, which all subsequent experience has proved to be erroneous. Mr. Wilson generously absolves the Admiralty from blame in the matter, but there are few who will be disposed to acquiesce in his apology. The side paddle continued in use in the navy, and to enter into the construction of war ships at the expense of the nation, for eighteen years after it should have been discarded for the screw, which Mr. Wilson urged upon their acceptance in 1827. In 1845 the Board accepted and adopted the screw propeller accredited to Mr. F. P. Smith, when in fact it was more properly the production of Mr. Wimshurst, a Thames shipbuilder, and hardly at all of Mr. Smith. Mr. Wimshurst asks the Admiralty to investigate, with a view to reward, if he is seen to deserve it, his claims to being the true inventor of the screw. If this investigation is conceded, we are disposed to put in a caveat for Mr. Wilson, for to him, we believe, most sincerely belongs the merit of the invention in question. Mr. Smith named his invention an "improved propeller," thereby, we may suppose, disclaiming the merit of originating screw propulsion, and nothing would seem more reasonable than that the Board of Admiralty should be asked to go a little farther back than the date of Mr. Smith's invention to find that one of which his is an improvement, and then most likely they will light upon the performances of Mr. Wilson.

WHO INVENTED THE SCREW PROPELLER?

(*From the "North British Daily Mail," 1st July,* 1872.)

Sir,—A very lively interest is taken by intelligent people in the settlement of this question. I believe they still live who are entitled to claim the honour of having invented the screw propeller, and there being several candidates in the field, it is proper that their respective claims should be considered by a discerning public. In your article of June 24th you favour the claims of Mr. Wilson, Dunbar, now of Manchester, and go into considerable detail in proof of your position. Mr. Wilson never patented his invention, his pecuniary means being inadequate. The rival claimant, Mr. F. P. Smith, did, and in 1836, and Captain Ericsson in July of the same year; and, in about a month after, Smith took out a patent in this country for a screw propeller, with which he experimented on the Thames. But although Wilson did not patent his invention, there are extant abundant public proofs that priority of claim should be assigned to him, and I agree with you in thinking so. Moreover, Smith's claims are now contested as you show, by a Mr. Wimshurst, formerly a ship builder on the Thames, who appears to have aided Smith (who, according to account, was not a mechanician, but a grazing farmer) in maturing his plans, and he (Wimshurst) afterwards produced a screw propeller, which he claims as his own. Now, the elementary conception of propulsion by screw action does not altogether suffice; the position of the screw in the ship, its form, and the

particular manner of applying the force to move it, are so many constituent parts of an effective screw propeller, and while we must allow for priority in the inception of this mode of propulsion, to him who first realised the thought in an available form should be accredited the invention. Wilson took up the idea of a screw propeller in 1808, the year in which his rival, Smith, was born, and it is on record that Smith began his operations in connection with screw repulsion in 1834, or 26 years after Wilson. In 1812, on to 1825, Wilson constructed various working models for the verification of his notions about screw propulsion. Between 1819 and 1821 he produced a model vessel, 30 inches long by 6 inches broad, with a stern propeller or "revolving scull," as he called it, having four blades. It is important to note that in Wilson's first experiments the propeller was placed in the stern and in advance of the rudder, just as we place the propeller now, the rudder being hung on a second or false stern-post. An inner stern-post was introduced on which the construction lines of the vessel terminated. This plan was in perfect consistency with the original idea of Wilson, to propel a ship by a revolving scull. In your article you notice the suggestions which Wilson derived from the scull oar, from an undershot wheel, and the sails of a windmill, in the construction of his so-called "rough sea" or "storm paddles." Now, Smith tried to introduce the propeller under the body of the ship and towards, but not at, the stern. He afterwards, I believe, attached the propeller at the stern, but in this he appears to have been anticipated by Wimshurst; but both these inventors were at least fourteen years later in this plan than Wilson. The plan of employing the propeller not in advance but behind the rudder was at a later date tried by Wilson, he finding at the time better results by following this plan. About this time (1828) a 25 feet boat in Leith was fitted up with a screw propeller and experimented on in the Firth of Forth by Vice-Admiral Sir David Milne, and naval Captains Boswell and Trotter, and others, under the auspices of the Highland Society of Scotland. The identical propellers and machinery used on this occasion are still extant, and in possession of Capt. Hunter, of Thurston. Mr. Wilson received from this Society £10 for his invention. In this case the propeller was placed behind the rudder. At the close of 1827, the Earl of Lauderdale, after witnesing the successful results of Mr. Wilson's model propeller, undertook to bring the invention before the Lords of the Admiralty. "My Lords" declined even to witness the experiments with his model, or to take any notice whatever of the invention. In the meantime, the Edinburgh newspapers published the invention, and the Dunbar Mechanics' Institution made a record of it in their minutes. In 1832, four years before the date of Mr. Smith's patent, we find Mr. Wilson before the Society of Arts, Edinburgh, with his invention, and a report of experiments at sea with it, recorded in the minutes of that Society, describing it as possessing "manifest advantages over the common side-paddles, and could be easily adapted not only to merchant ships, canal boats, and steamboats generally, but also to ships of war. The paddles can be kept under water, and out of the reach of shot, and answer equally well in rough as in smooth sea." The Society's Silver Medal was bestowed on Mr. Wilson that year (1832). So much, then, for priority in the invention; and for the position of the screw in the ship, in particular, which Wilson can certainly claim. Then as to the forms given to the earlier screw propellers, in after years the forms have been greatly varied. Mr. Wilson at first used four blades for his propeller in imitation of the wind-mill, each blade being equal to about the eighth part of a whole turn of a four-threaded screw, with clockwork as the actuating power. He then tried three blades with still better results, when the motion was quickened, and latterly a great many experiments were made with the two-bladed screw, the vanes being set at various angles, or pitches, and made of different breadths,

but none of the blades tried exceeded one sixth of the whole turn of a screw. In the two the blades were cut away at the boss to a sharp twisted arm set with a twist corresponding to the speed of the model, or rather to the slip of the screw. This plan closely resembles the form of screw-paddle adopted many years after in Maudslay's feathering screw shown in model in London, 1862. Mr. Robert Griffiths exhibited on the same occasion two screw propellers, one having two and the other three blades. The roots of these blades were fastened into a boss formed round the axis of the screw shaft. Neither Maudslay nor Griffiths showed anything new on Wilson's plan of 1827, excepting in the forms of their blades, and the facility of feathering them, which last was also in measure available for Wilson's method, while Maudslay could feather his blades by mechansim, worked on the ship's deck. I hesitate not to affirm that the solid merits of the invention, to this hour remain with Mr. Wilson. Further, as to the method of driving the screw propeller, in his first attempts with little models, Wilson used clock-work, as I have above stated. Steam navigation was then in its infancy and hardly known to Europe (1812-19). It was an ingenions thought of Wilson to introduce a horizontal wind-wheel on a ship's deck to work the revolving scull in the water, and thus to drive the ship against the wind if required. All along, after steam navigation had been introduced he saw that "a stern scull" or screw propeller was the proper apparatus for sea-going steamers. In 1821 he witnessed the extreme peril of the "Tourist," steamer, off Dunbar owing to the unfitness of paddles for a rough sea. This vessel rolled from side to side, and her steam power was rendered nearly useless from the side-paddles alternately dipping under water and then emerging wholly into air. Wilson felt his way slowly in regard to the mode of driving his propeller, approaching more and more closely to our present plan. Curiously enough he made a step back in 1821 to 1825, in placing, contrary to his earlier method, the rudder in advance of the screw. The stuffing box of the propeller shaft leaked when the shaft worked direct and with the screw in advance of the rudder, and to get rid of this inconvenience, which damaged the clock-work, we find him, in his model of 1826, introducing toothed rectangular gearing, in connection with a vertical shaft under water, driven from the ship's deck to urge the propeller. The screw could thus be attached to the outside of the ship's hull and hand-worked from above by means of cranks. Four years' later, or in 1832, we find in the model with which he experimented before the Society of Arts, Edinburgh, a return to the old method of directly driving the propeller shaft from within the vessel. The screw shaft was prolonged within, the ship having on its inner end a pinion which geared into a wheel on the crank shaft on deck. It would, of course, be a mere detail of mechanism to attach this screw shaft with its pinion to a steam engine in the hull of the vessel, and then we should have something closely akin to our present plan of screw propulsion by steam. On the whole, then, I think we may fairly deduce the conclusion that the invention of the screw propeller belongs to Mr. Robert Wilson, of Dunbar, and this opinion is indirectly confirmed by what is stated in your article, that Mr. Smith, in his patent of 1836, called his "an improved propeller." Apologising for the length of these reasonings and remarks,

I am, &c.,

A Constant Reader.

Glasgow, June 28.

(*From the "North British Daily Mail," Glasgow, 5th August,* 1872.)

WHO INVENTED THE SCREW PROPELLER?

To the Editor of the "North British Daily Mail."

SIR,—Kindly allow me space for a few remarks on the above subject, and permit me in the offset to say that I think the public interested in this matter must feel indebted to you for allowing a correspondence on the subject in your widely-circulated and influential paper. It is, as you evidently consider it, of real importance to ascertain to whom is due the honour of one of the greatest inventions of modern times—the screw propeller. Having, as I believe, read most if not all of the authorities and notices on the subject, I have no hesitation in repeating what you have already indicated—viz., that the gentleman entitled to the honour of the invention is the well-known engineer, Mr. Robert Wilson. At the very outset we have this in Mr. Wilson's favour, that he must necessarily have engineering talents of a high order, seeing that he is the only acting partner in the eminent firm of Messrs. Nasmyth, Wilson, & Co., Patricroft, Manchester—a firm of world-wide notoriety, owing, amongst other successes, to their invention and improvement of the steam hammer. On referring to a pamphlet published by Messrs. Thomas Murray & Son, of Glasgow, so far back as 1860, and in which the invention is claimed by Mr. Wilson, I find that Mr. Wilson's claim is put as follows, viz. :—

"Steam navigation, which has done so much for the prosperity of nations and the grandeur of Britain, has called forth many inventions, and amongst the most important of them is the screw propeller. This invention, as the most suitable for propelling ships of war and other ocean steamers, I now for the first time publicly claim as my own, and I am confident that I shall be able to establish, by undoubted documentary evidence, that I not only invented, and tested on the sea before the Committees of the Highland Society and Society of Arts, but at great personal sacrifices used all the means in my power to introduce the screw propeller for ocean navigation long before Mr. Smith, the patentee (who has reaped the honours and rewards of the invention), had even his attention directed to the subject; and that the screw might have been adopted in the navy as early as 1827, to the saving of millions of the public money. In that year the Lords Commissioners of the Admiralty refused to countenance my invention, though recommended to their notice by the Right Honourable the Earl of Lauderdale; and again in 1833 they rejected it because (to quote from the official report af the officers of Woolwich Dockyard) 'it involved a greater loss of power than the common mode of applying the wheels to the side,' a decision which (as the Secretary of the Royal Society of Art expressed it) 'just resolved itself into a preference to side paddles over the screw or stern paddles.'"

This statement of the case puts it in very distinct and narrow limits, and there is at page 36 of the pamphlet a copy of an official report, dated 17th September, 1833, to the effect that the Lords Commissioners of the Admiralty had had reported to them that the screw propeller was inferior to the side paddles. But for this most erroneous report I do not see how it can be even doubted that the invention and the honour and reward of the same properly belong to Mr. Wilson; and it must be obvious that, had the report been favourable to the screw propeller, that the Government could not have hesitated to admit the obligations of the country to Mr. Wilson. The great point in Mr. Wilson's favour is this, that he was admittedly the very first to bring before the Government in a practical form this important discovery, and that he did not bring it forward in a crude shape, but only after

it had been thoroughly tested, and had met with the special approval of well known public bodies in Scotland, and of the Earl of Lauderdale, and a number of eminent noblemen and gentlemen. The *Practical Mechanics' Journal*, the *London Mechanics' Magazine*, a writer in the *Standard*, the *Manchester Review*, and others, have expressed their views in favour of Mr. Wilson. The *Review* says:—"It is plain that Mr. Wilson was the real inventor of the screw propeller." Another newspaper says:—"The publication of this modest narrative unequivocally proves the claim of Mr. Wilson to priority of invention, and entitles him to the thanks of his countrymen as adding another to the list of those illustrious Scotsmen who have by their native talent augmented the mechanical resources of the age." In common fairness, and as an encouragement to inventors, it is to be hoped that the Government will order an enquiry as to who was the original practical inventor of the screw propeller, and as to who first brought it in a practical form before Government. If it be found, as I believe it will be, that Mr. Wilson is entitled to the honour, then I hope Government will not object specially to acknowledge this. I enclose my card.—I am, &c.,

C.

EDINBURGH, August 2.